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NINTH ANNUAL REPORT

OF

THE RESEARCH DEPARTMENT

OF THE

COFFEE BOARD

1955-1956

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COFFEE BOARD

RESEARCH DEPARTMENT

NINTH ANNUAL REPORT OF THE RESEARCH DEPARTMENT

(July 1955 to July 1956)

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60	1	3	B.H.C. 50 per cent W.P.	B.H.C. 50% W.P. at 1.0%ac.
61	1	12	Dieldrin W.P.	Dieldrin 50% W.P.
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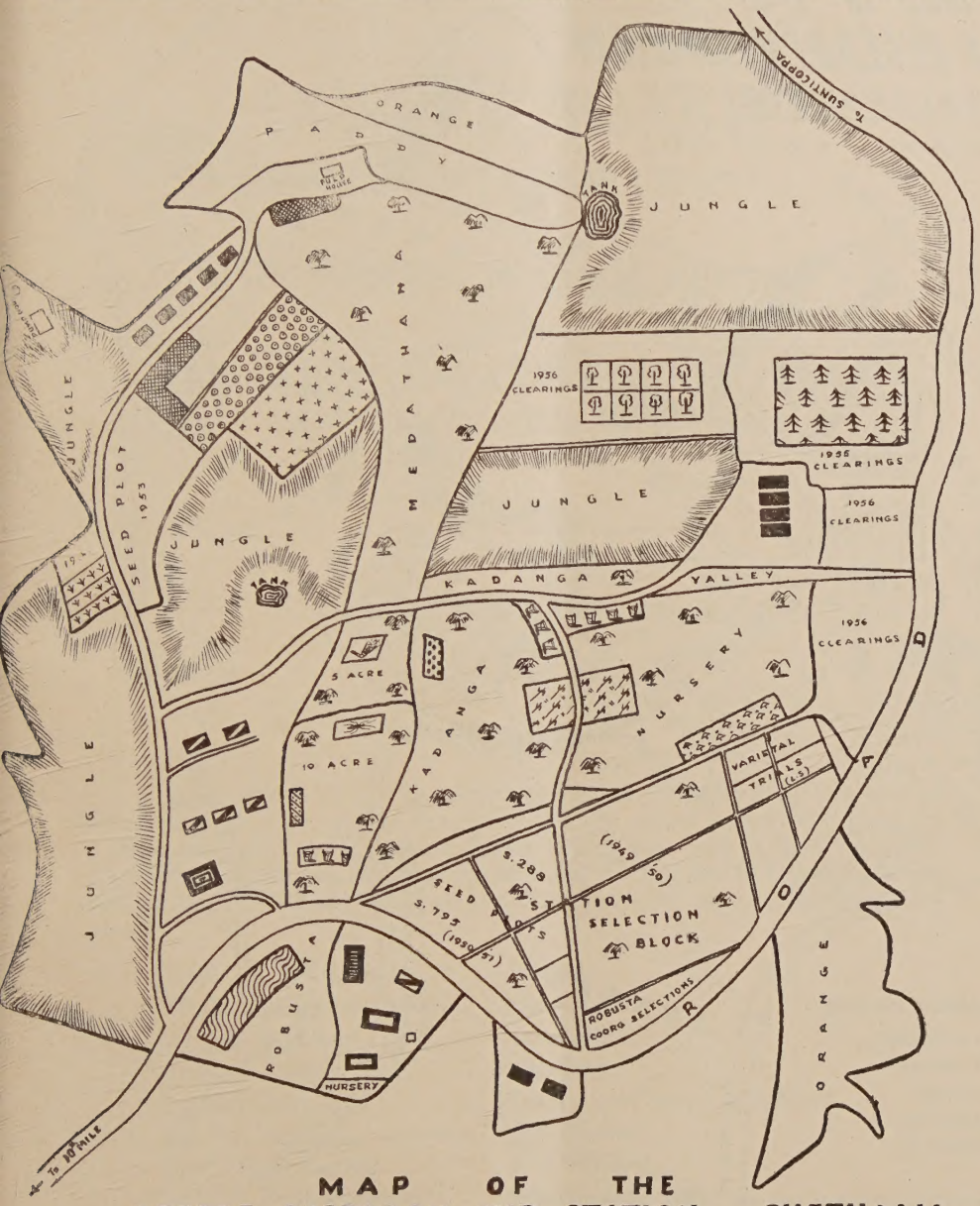
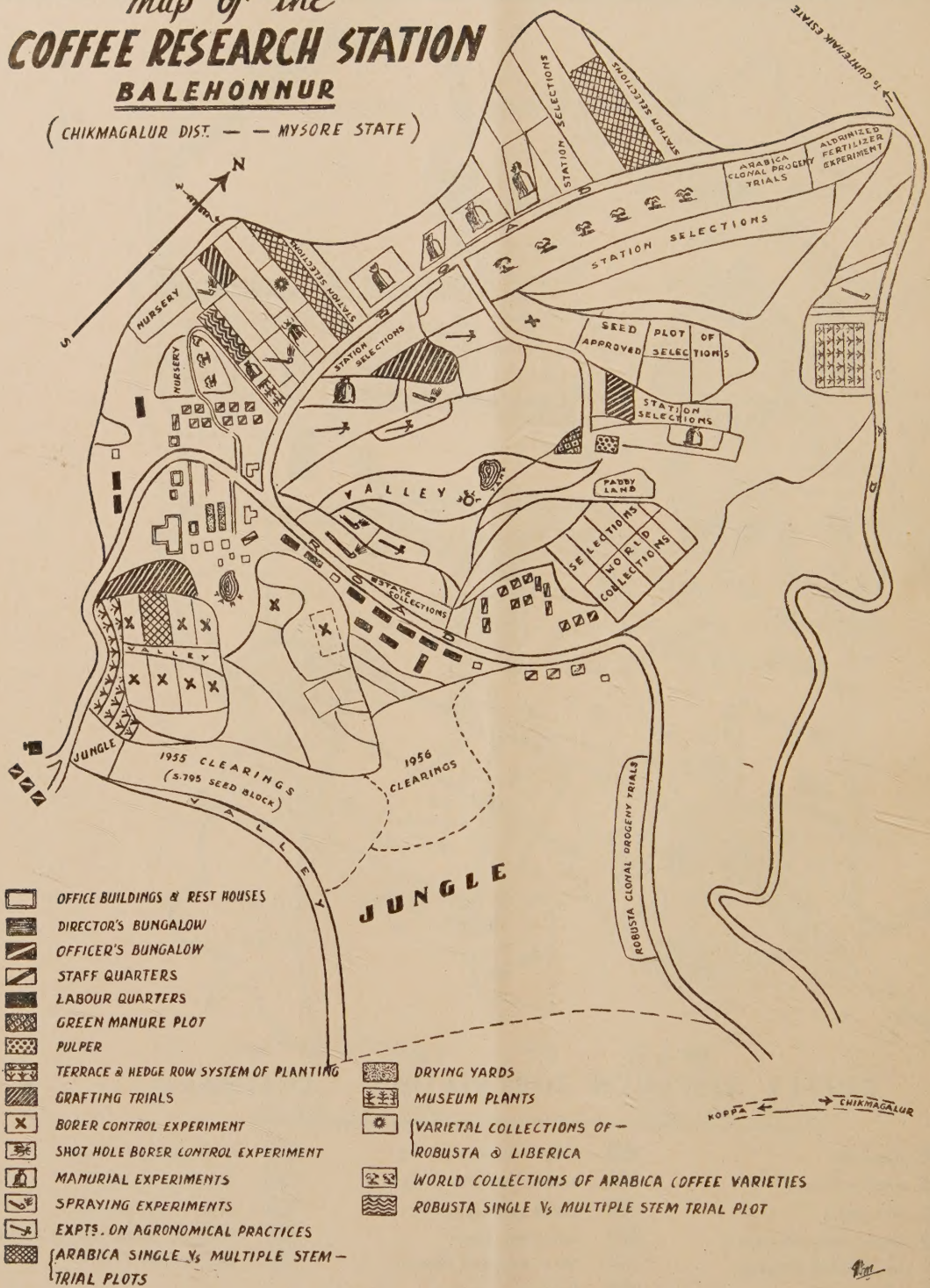


MAP OF THE COFFEE RESEARCH SUB-STATION - CHETHALLI

COORG DISTRICT MYSORE STATE

- LABORATORY
- OFFICE & STORES
- REST HOUSE
- SENIOR STAFF QUARTERS
- JUNIOR STAFF QUARTERS
- LABOUR LINES
- HEDGE ROW PLANTING
- ARABICA SINGLE V/S MULTIPLE STEM TRIALS
- ARABICA MANURIAL EXPTS
- ROBUSTA MANURIAL EXPTS
- BORER CONTROL EXPTS
- SPRAYING EXPTS
- FIELD MANURIAL TRIALS
- TEST SCALE TRIALS
- ALDRINISED FERTILISER TRIALS
- CULTIVATION EXPTS
- PHYTOTOXICITY TRIALS
- SINGLE SHADE EXPTS
- SHADE EXPERIMENTS
- ROBUSTA DEMONSTRATION PLOTS
- BULK COFFEE AREAS

Map of the
COFFEE RESEARCH STATION
BALEHONNUR
(CHIKMAGALUR DIST. — — MYSORE STATE)



- OFFICE BUILDINGS & REST HOUSES
- DIRECTOR'S BUNGALOW
- OFFICER'S BUNGALOW
- STAFF QUARTERS
- LABOUR QUARTERS
- GREEN MANURE PLOT
- PULPER
- TERRACE & HEDGE ROW SYSTEM OF PLANTING
- GRAFTING TRIALS
- BORER CONTROL EXPERIMENT
- SHOT HOLE BORER CONTROL EXPERIMENT
- MANURIAL EXPERIMENTS
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- EXPTS. ON AGRONOMICAL PRACTICES
- ARABICA SINGLE Vs MULTIPLE STEM — TRIAL PLOTS
- DRYING YARDS
- MUSEUM PLANTS
- VARIETAL COLLECTIONS OF — ROBUSTA & LIBERICA
- WORLD COLLECTIONS OF ARABICA COFFEE VARIETIES
- ROBUSTA SINGLE Vs MULTIPLE STEM TRIAL PLOT

COFFEE BOARD

RESEARCH DEPARTMENT

THE NINTH ANNUAL REPORT

OF THE

RESEARCH DEPARTMENT OF THE COFFEE BOARD 1955-1956

INTRODUCTORY

PART I

ADMINISTRATION

I was in charge of the Research Department throughout the year except from the 22nd June 1956 till the end of the year under report when I was on a coffee study tour out of India in British East Africa. Dr N. G. Chokkanna, Chemist, was placed in charge of the duties of the Director of Research during that period. The following officers continued to hold charge of the respective posts:

Dr N. G. Chokkanna	*Chemist*
Sri R. L. Narasimhaswamy	*Botanist*
Dr S. A. Raja Rao	*Entomologist*
Sri K. V. George	*Mycologist*
Sri K. B. Ponnappa	*Secretary to Director of Research*
Sri P. K. Mathew	*Asst. Chemist*
Sri S. Vishveshwara	*Asst. Botanist*
Sri T. V. Pattabhiraman	*Senior Liaison Officer*
Sri S. J. Mathias	*Junior Liaison Officer*
Sri H. S. Puttuswamy	,,
Sri K. T. Bhagat	,,
Sri B. K. Chandrappa	,,
Sri G. I. D'Souza	,,
Sri W. Raghavendra Rao	,,
Sri R. Vijaendraswamy	,,

2. Sri T. V. Pattabhiraman, Senior Liaison Officer, stationed at Chethalli, held full additional charge of the duties of the Superintendent, Coffee Research Sub-Station, Chethalli, till 24-10-1955, when he was posted to the newly formed Madras liaison circle with Coimbatore as headquarters.

3. Sri R. Vijaendraswamy, Junior Liaison Officer, was placed in additional charge of the duties of the Superintendent, Coffee Research Sub-Station, Chethalli, from the 24th October 1955, and continued as such till the end of the year under report, except for a short period of 35 days from the 12th March to the 15th April 1956, when he was on earned leave and Sri C. Ramakrishnan Nambiar, Superintendent on probation, held charge.

4. Sri C. Ramakrishnan Nambiar who was selected for the post of Superintendent, Coffee Research Sub-Station, reported on the 2nd February 1956, and was under training at the Research Stations and in a private estate.

Extension Service

5. In addition to the overall direction and supervision of the Liaison service, I held direct supervisory charge of the Liaison divisions in Mysore State and Shevaroys. Sri T. V. Pattabhiraman, Senior Liaison Officer, was in supervisory charge of the liaison divisions of Nilgiris-Malabar-Wynaad and North Coorg.

6. Sri T. V. Pattabhiraman held direct charge of the South Coorg Liaison division and the Coimbatore division comprising of Anamallais, Pulneys, Nelliampathies and other coffee areas in Travancore-Cochin State. The latter tracts presented a very peculiar problem of mixed cropping with coffee and posed an urgent question for rejuvenating of most of that area. Repeated representations from planters of the urgency of establishing a separate and independent Liaison division covering these tracts necessitated the readjustment of jurisdictions. These areas also demanded the posting of a senior and experienced officer. A new Liaison division comprising of the Anamallais, Pulneys and Nilgiris was constituted with headquarters at Coimbatore, and Sri T. V. Pattabhiraman was posted to hold charge of that division. He continued to supervise the work of the liaison divisions of Shevaroys and Wynaad.

7. Sri R. Vijaendraswamy completed his training during the year and was posted to the charge of the South Coorg Liaison division with headquarters at Chethalli.

8. Sri K. C. Ananth, who was selected for appointment as a Junior Liaison Officer in January 1956, was under training at the Research Stations and private estates.

9. The sanctioned strength of officers and staff of the Department continued to be 2 in the Administrative section, 31 in the Technical sections, 29 in the Liaison section, 17 in the Ministerial section and 6 in the Farm and Estate sections. The vacant posts of one Agronomist, one Junior Liaison Officer and one each of Research Assistants in Chemistry and Plant Pathology were re-advertised in May 1955 and that of Superintendent, Coffee Research Sub-Station in June 1955. Candidates were selected for these posts and all except the candidate selected as Agronomist, reported for duty during the year.

10. Two posts of clerks and 20 posts of Fieldmen that were vacant at the end of the previous year were filled during the year by recruitment of 2 clerks, 2 Fieldmen, and 18 Fieldmen trainees to be appointed as Fieldmen on completion of a period of training in the Research Stations and on private estates over nine months. The first batch of 6 Fieldmen trainees are expected to complete the training by the end of August 1956, and the second batch of 12 by middle of March 1957.

11. The following appointments of staff were made during the year:

1. Sri K. C. Ananth, M.Sc. (Agr.), as Junior Liaison Officer from 16-1-1956 (under training).
2. Sri C. Ramakrishnan Nambiar, B.Sc. (Agr.), as Superintendent, Coffee Research Sub-Station, Chethalli, from 2-2-1956 (under training).
3. Sri B. R. Venkatanarasimha Iyengar, B.Sc., as Research Assistant in Chemistry from 1-12-1955.
4. Sri Mehboob Sheriff, B.Sc. (Agr.), as Research Asst. in Plant Pathology from 2-2-1956.
5. Sri Khaleel-ur-Rahman as Junior clerk from 20-2-1956.
6. Sri C. N. Narasimhamurthy as Junior clerk from 19-8-1955 (transferred from Marketing Dept.)
7. Sri K. P. Joseph as Junior Clerk from 30-6-1956 (promoted and transferred from the Propaganda Department).
8. Sri K. Krishnankutty as Fieldman from 4-6-1956.
9. Sri B. G. Nanjappa as Fieldman from 5-6-1956.

12. Sri H. T. Ranga Setty, B.Sc., B.Sc. (Agr.), Plant Protection Assistant at the Coffee Research Sub-Station, Chethalli, officiated as Junior Liaison Officer, North Coorg Division, vice Sri K. T. Bhagat B.Sc. (Agr.), granted earned leave from 26th March to 9th May 1956.

13. Sri C. Sarangan and Sri K. N. Anantharamaiah who worked as temporary junior clerks during the year left the Department on expiry of their term of appointment.

Leave

14. The following officers were on leave during the year for periods noted against each:

1.	Dr N. G. Chokkanna, Chemist	... 6	days
2.	Sri K. V. George, Mycologist	... 49	,,
3.	Sri G. I. D'Souza, Junior Liaison Officer	... 21	,,
4.	Sri K. T. Bhagat, Junior Liaison Officer	... 45	,,
5.	Sri Vijaendraswamy, Junior Liaison Officer	... 35	,,

Tour

15. I was on tour for 211 days in the year to attend the meetings of the Board and its Committees and to visit coffee areas in Coorg, Mysore, Shevaroys, Wynaad and Nilgiris on both exploratory and advisory work. I visited 59 big and over 120 small estates. The Sub-station at Chethalli was visited eight times during the year covering a halt of 28 days. I was on deputation out of India for 8 weeks from the 22nd June 1956 on a study tour in the coffee zones of Kenya, Uganda and Tanganyika.

16. Dr N. G. Chokkanna, Chemist, was on tour for 92 days in the coffee areas in Mysore, Coorg and Nilgiris, in connection with advisory work in problem areas on soil management and nutritional requirements, exploratory work on the field manurial trials at the Research Stations and private estates and visiting the sub-station at Chethalli.

17. Sri R. L. Narasimhaswamy, Botanist, was on tour for 66 days in the coffee areas in Mysore, Coorg and Shevaroys, inspecting seed blocks of Station selections and collection of promising plant material for future work. He was on deputation out of India on a study tour for 8 weeks in the British East Africa Coffee areas from 22-6-1956.

18. Dr S. A. Raja Rao, Entomologist, was on tour for 51 days to visit private estates and sub-station at Chethalli to lay out exploratory field trials on pest control.

19. Sri K. V. George, Mycologist, toured for 28 days to visit problem areas and to lay out exploratory field trials on disease control.

20. The Research Assistants and field staff in the several technological sections were deputed to experimental and problem blocks in the different zones for execution of programmes.

Construction of Buildings

21. Negotiations were initiated early in the year with the Public Works Departments of the Governments of Mysore and Coorg States to assist the Board by taking over building and other constructional works at the two Research Stations. It was hoped that this arrangement would help in expediting operations and in a more thorough technical supervision of works. The Government of Mysore have lately intimated their consent for the State Public Works Department to take over the constructional works of the Research Station at Balehonnur on concessional terms applicable to non-profit making government and government-aided institutions. It is hoped that the actual transfer of the responsibility of the works will be completed early in the next season. In the meanwhile on account of urgency of some of the works to be undertaken, the usual procedure of entering into contract with approved contractors was adopted early in January of the year. Due to the shortness of the season, progress was limited to about 50 per cent of the anticipated programme.

22. For want of proper assistance and reliable contracting agency to undertake the works, the programme of building and other works at the Coffee Research sub-station, Chethalli, was deferred till the Government of Coorg came over to the rescue late in March to take over the execution of the programme for 1955/56. The Department is indebted to the two Governments for their help and consideration.

Library

23. Six new journals were added to the library bringing the total number of journals by subscription to 52; 18 journals continued to be received on exchange basis, bringing the total number of journals received at the Station to 70 against 64 in the earlier year.

24. One hundred and thirteen books were added to the reference section bringing the total number of books to 821. 23 of these were received as gifts from individuals and Institutions.

25. Fifty-three volumes of loose numbers of old journals were got bound.

26. Four physical and geological maps of the World, India, Africa and South America were purchased and displayed for ready reference.

27. With a view to equip the Liaison Officers with standard books of reference on soil management, fertilizers, plant protection, plant production and horticulture, a total of 60 books were purchased and supplied.

Meetings

28. I attended two ordinary and one special meeting of the Board, two meetings of the Executive Committee and two meetings of the Research Committee. Two meetings of the Officers of the Technical and Extension arms of the Department were held at the Coffee Research Station, Balehonnur, to discuss and review the programme of research, extension and administrative matters, and related subjects, and the preparation of schemes for development of coffee.

Informal meetings with heads of sections and field staff were held once a month at Balehonnur and four times at the sub-station at Chethalli during the year.

29. I attended meetings of the M.P.A. and I.P.A., Chikmagalur, and an informal meeting of the Shevaroy planters at Yercaud. I addressed a meeting of the Coorg Planters' Association on manurial problems with special reference to robusta. I addressed these meetings of the Planters' Associations on technical aspects of soil management, plant protection and shade regulation and held post-meeting discussions with groups of planters. I also addressed the Indian Planters' Association, Chikmagalur, on some aspects of the Development Plan.

Ad Hoc Committee

30. The ad hoc committees both for the Coffee Research Station, Balehonnur, and the sub-station, Chethalli, were re-constituted early in 1956 and the following members served on the committees:

1. Director of Research (Ex-officio Chairman) 2. Sri A. M. Basave Gowda 3. Sri U. K. Lakshman Gowda 4. Sri K. M. Verghese Mapillai 5. Sri D. A. Graham Dr N. G. Chokkanna, Chemist (*Secretary*)	Ad hoc committee for the Coffee Research Station, Balehonnur.
1. Director of Research (Ex-officio Chairman) 2. Sri G. M. Manjanathaya 3. Sri D. V. Dasappa 4. Sri K. A. Aiyapa 5. Sri S. S. Narayana Murthy Sri R. Vijaendraswamy, Officer-in-charge (*Secretary*)	Ad hoc Committee for the Coffee Research Sub-Station, Chethalli.

One meeting at the Coffee Research Station, Balehonnur, and two at the Coffee Research Sub-station, Chethalli, were held.

31. I express my gratitude to all the members of the Ad hoc Committees for their very valued advice and assistance in the management of the estates of the two Stations.

Exhibitions and Conference

32. I and the Chemist attended the Scientific Conference of the U.P.A.S.I., Coonoor, held in August 1955, and the Department participated in the exhibition at that time.

33. The Department also participated in the Agricultural Seminar organized by the Mysore Department of Agriculture at Bangalore in May 1956. Exhibits and charts were sent for the exhibition in connection with the Dasara celebrations in Mysore in October 1955.

Correspondence

34. The number of letters dealt with during the year were as follows:

	Balehonnur	*Chethalli*
Inward:	15,073	3,246
Outward:	17,468	4,552

Correspondence dealt with at the Coffee Research Satation, Balehonnur, show an increase of 50 per cent over the last year. Advisory correspondence show definite increase and a good part of it is outward communication.

Audit of Accounts

35. The audit of accounts for the year 1954/55 of the Coffee Research Station, Balehonnur, and the Coffee Research sub-station, Chethalli, were conducted in the months of September and October 1955, and January 1956, respectively. The Accounts officer of the Board conducted an interim check of accounts in August 1955, at the Balehonnur station and in February 1956, at Chethalli.

Budget

36. The budget for the year under report anticipated a programme of expenditure of Rs 2,27,000 under Captial inclusive of Works, and Rs 4,96,600 under Recurring inclusive of estate maintenance. An actual expenditure of Rs 4,42,900 under recurring charges including maintenance of estates and Rs 1,22,350 under Capital including works was incurred. There was a considerable reduction in Capital Works as part of these had to be deferred for one reason or other.

37. The budget for the year 1956/57 anticipates an expenditure of Rs 2,79,000 on Capital Works and Rs 6,35,300 on Recurring expenditure. The expansion of technical sections and the demonstration and exploratory activities of the Liaison section accounting in large measure to the increasing expenditure of the Department.

38. The revenue receipts for 1955/56 were Rs 1,81,220 against a revised estimate of Rs 1,52,500 a higher crop of coffee and a more generous issue of pedigree seed material account for this added income. Revenue receipts for 1956/57 are estimated at Rs 1,94,300.

Visits

39. The Coffee Research Station, Balehonnur, received over 500 planters and others interested in planting industry. It was encouraging to note that the trend noticed last year of groups of small planters visiting the Station either with the Liaison Officers of their division or of their own accord continued in an increasing tempo. A special feature was the visit to the Station of three groups of small planters numbering over a hundred in all. Students from the Agricultural College and School, Hebbal, visited the Station during the year as part of their annual training in plantation crops.

40. The Station was privileged to receive the following distinguished visitors:

1. Shri P. V. S. Sarma, M.A., B.L., Deputy Secretary, Ministry of Industry and Commerce, Govt. of India.
2. Shri K. Srinivasan, I.A.S., Chairman, Coffee Board.
3. Dr V. Subrahmanyan, Director, Central Food Technological Research Institute.
4. Mr C. A. Krug, Director of Agronomic Institute, Sao Paulo, Brazil.
5. Dr Van Dierendonck of the Centre D'Etude de L'Axote, Geneva—of the Chilean Nitrate Corporation.
6. H. E. the Bishop of Mysore.

41. Over 300 planters and others interested in coffee industry visited the Sub-station during the year under report. As in the case of the Coffee Research Station, Balehonnur, it was interesting to note that there was frequent inflow of groups of small planters to see, learn and discuss the development in scientific management of coffee. These visits enable the extension arm stationed at the

Sub-station to secure closer contact with clientele. The station had the privilege of receiving the following visitors:

Shri T. G. N. Iyer, I.C.S., Chief Commissioner of Coorg.
Shri K. Srinivasan, I.A.S., Chairman, Coffee Board.
Shri M. P. Patil, Minister for Co-operation, Bombay.
Shir P. K. Sen, Accountant-General, Mysore.
Shri M. Balakrishnan Nair, Agricultural Adviser, (Shift Cultivation) Assam.

The Department is particularly grateful to Shri T. G. N. Iyer, Chief Commissioner of Coorg, and the Hon'ble ministers for their frequent visits to the Station and the continued interest evinced by them in so doing.

Training in Coffee Culture

42. Under the scheme of training in coffee culture described in the annual report for the previous year, a nominee of the Tea Estates (India) Ltd., the second from this organization and the Assistant Botanist of the Agricultural Department, Orissa, (a nominee of the Orissa Government) were trained during the year for the full period of 3 months in two stages. A nominee of the Glenburn Estates Ltd., had just started on his training at the close of the year under report.

43. The scheme obviously seems to have attracted the attention of planters, Planting Associations and corporations as reflected by the numerous enquiries for training facilities that are being received at this end. It was encouraging to note that the Associations whose candidates had been trained in the earlier instance felt that this training was both interesting and useful.

44. The scheme as at present sanctioned is however limited to training of not more than 6 candidates in any one year over a period of three months in two phases of 6 to 10 weeks at a time. In view of the large demand, proposals are under consideration for enlarging the scheme to permit a larger number being trained. Concurrently proposals are also under consideration for a short refresher course for workers on estates of the category of fieldmen, writers and maistries in systematic and scientific cultural practices.

Annual Celebrations

45. The Independence Day and the Republic Day were celebrated at both the Stations. The mazdoors were granted holidays with wages on these days and entertained to sports and refreshments.

Exchange of seed Material

46. The Station is indebted to the following persons and institutions for sending valuable coffee and other seed and seedling material:

1. Coffee Specialist, F.A.O., Adis Ababa, Ethiopia.
2. Head of Institute of Agricultural Research, Bogor, Indonesia.
3. Antoine Delfonte Esq., Compagnie, Hauts plateau, Indochinois, Bureaux A Saigon, Ngo-due-Ke, Saigon.
4. Ernst P. Imle Esq., Tropical Crops Plant Introduction Section, U.S. Dept. of Agriculture, Horticultural Crops Research Branch, Beltsville, Maryland, U.S.A.
5. Senior Research Officer, Dept. of Agriculture, Ruiru, Kenya.

Publications

47. Popular notes on technological problems of immediate interest to planters were issued during the year on the following subjects and published in the *Indian Coffee:*

1. Selection of coffee plants for propagation, raising of seedlings in nursery and their aftercare.
2. Use of urea for root and non-root feeding of coffee.
3. Questions and Answers.
4. Travelogues—
   (*a*) Training of arabica coffee in relation to crop improvement on the Bababudangiris.
   (*b*) Stray thoughts on coffee in Kolli Hills (Salem Dt.)
   (*c*) Incidence and control of leaf disease of arabica coffee on the Bababudangiris.
   (*d*) Possibilities of re-introducing arabica in Malabar-Wynaad.
   (*e*) The nature of extension work in the Chikmagalur Liaison Division.
   (*f*) A new method of extraction of coffee plants from bed nursery and planting them out in the field.
   (*g*) Exploratory and demonstration work in Nilgiris-Malabar-Wynaad.
5. Brief abstracts from reports, bulletins and scientific journals dealing with coffee and related products.
6. Coffee maps of Liaison divisions.

48. A brief note on work done by the Research Department in 1955/56, was prepared and sent to the Ministry of Commerce and Industry, Government of India, and a technological synopsis of research programme of the Department was prepared and sent to the Ministry of Food and Agriculture, Government of India.

FIELD STATIONS

49. Sri T. V. Pattabhiraman, Senior Liaison Officer, in additional charge of the sub-station was transferred to the newly formed liaison circle of Coimbatore, and Sri R. Vijaendraswamy, Junior Liaison Officer, South Coorg, replaced him in the administrative and financial charge of the sub-station. Sri C. Ramakrishnan Nambiar of the Madras Agricultural Department, was selected to fill the vacant place of the Superintendent and was under training at the Research Station and private estates.

50. There was no change in the managerial charge at the Coffee Research Station, Balehonnur.

SEASON AND CROP

Balehonnur

51. The total rainfall during the comparable 12 months of the year (July to June) was as low as 86.87 inches against a decennial average of 113.30 inches and a high precipitation of 129.60 inches in the earlier year. The total rainfall for the 13 months covering the period of the report was 124.48 inches, the month of July contributing 37.61 inches, 2.59 inches more than the decennial average for the month. (*Appendix I and II*)

52. The South West Monsoon of 1955 which started well and in a satisfactory manner in the beginning of June, belied hopes and weakened considerably thereafter; sub-normal rainfall conditions prevailed in July and August with a scanty 9.52 and 15.32 inches of rainfall against a decennial average of 37.82 inches and 27.04 inches in these respective months.

53. The precipitation was however distributed throughout the year excepting a short dry season of December 1955 and January 1956, which seemed to compensate in an appreciable measure for the short fall in total rain.

54. The summer showers were small with 46 cents in February and 1.19 inches in March. April recorded a precipitation of 6.19 inches (with a fall of 4.04 in one single day). Weather conditions in May forecast a possible onset of an early monsoon but the regular South West Monsoon did not commence till the third week in June 1956, though frequent and light showers were received during part of May and early June. The monsoon strengthened and the month of June recorded a rainfall of 28.30 inches against the decennial average of 15.62 inches, establishing a record in the history of the Station at Balehonnur. The condition in July as stated above assured the continuance of a strong and copious monsoon.

55. The blossom showers of 1956 were spread over a period of weeks in February, March and April, resulting in running blossoms in waves in contrast to the one blossom in the previous year. Distributed light showers in the earlier instance caused 'paddying' to a small extent but the harm was mitigated in appreciable measure as these showers served as backing rains for the early blossoms. It was encouraging to note that the trend observed over the past two years of an evening out of crops and a gradual but perceptible increase in yield of crop continued.

56. The average yields on bearing area was 4.66 Cwt. against 4.53 Cwt. in the earlier year.

Chethalli

57. A total rainfall of 55.49 inches was received during the year which fell short of 17.32 inches of the decennial average. Even distribution throughout the major part of the year and a short dry season in December and January 1956, as in the earlier case compensated in large measure for this short-fall in total rain and crop prospects were particularly good. (*Appendix III*)

58. An early and inadequate shower of 50 cents at the end of January, forced the blossom on nearly 25 per cent of Arabica and over 50 per cent on Robusta. Continuous drought till early April resulted in poor setting of Robusta. A fair precipitation of over 1 inch on three successive days in early April, helped in the opening of the rest of the blossom in Arabica and Robusta. Backing showers in late April and early May helped in assuring, surprisingly enough, a more than average crop.

59. The crop of 14.85 tons picked during the year was peculiarly close to the estimate. The crop estimates on the blossom and post-blossom settings are set at 23.5 tons for the crop year 1956/57. The trend of even crops and increasing average yields continue to be maintained at this Station also.

DISEASES AND PESTS

Balehonnur

Leaf Disease

60. The year 1955 saw again a comparatively heavy incidence of leaf disease. Wet weather attacks of leaf disease were unusually heavy during the year. The peculiar premonsoon weather conditions of intermittent rain and sunshine and the comparatively light monsoon rains during June, July and August 1955, were very favourable for an outbreak and quick spread of the disease and this resulted in considerable defoliation during July and August. Immediate attention to ameliorative measures like provision of proper drainage

and application of bulky organic manures like fish-meal and compost to act as a pick-up gave very good response and resulted in a marked recovery of the bushes without much die-back and crop losses. The early setting in of North East Monsoon and the unusually wet September and October, the light showers received during November and the misty mornings resulted in a second incidence of leaf disease which reached a peak incidence during November—December 1955. This was followed by a heavy shed of infected leaves during the latter half of December 1955, throughout January 1956, and the first half of February 1956. Some amount of die-back also followed; but as crop harvest was over there was no immediate crop losses. This heavy incidence of leaf disease resulted in a more or less complete defoliation of all infected leaves by middle of February 1956, and this reduced the source of disease inoculum carried over for 1956. Though the dry period was very short (December—January) and the pre-monsoon weather conditions in 1956 was very favourable for the disease spread (intermittent showers in February, March, April and May), the spread was practically negligible. This is perhaps due to the low disease carry-over from previous season and some time has to lapse before the disease could build up and start spreading.

Black Rot

61. Incidence of black-rot was negligible during 1955 South West Monsoon rains. The blocks which are endemic for black rot did show a mild attack of the trouble. Immediate attention to handling of diseased material and spraying with 1 per cent Bordeaux mixture checked further spread. During 1956, the disease has not been of any serious order.

Nursery Diseases

62. Some amount of pre-emergence damping off of seedlings in the nursery was observed in the primary germination beds due to *Rhizoctonia solani.* However, after transplanting to baskets and to secondary beds, the seedlings were comparatively free from any serious infection.

63. Brown-eye-spot disease due to *Cercospora coffeicola* appears to be gaining importance as a major trouble in nursery seedlings and in young areas. Attention to proper sanitary measures in the nursery and a routine 1 per cent Bordeaux mixture spray at monthly intervals kept the disease fairly under control.

Coffee stem borer

64. Infestation with stem borer was as low as 0.35 per cent of the total plant population on the estate. Against an yearly average of over 5,000 plants removed in the quinquennium 1949-54 and in 1947 only 707 plants were removed during the year under report. A regular programme of rigid tracing of borer and removal of bored plants and the continuance of the equally regular programme instituted in 1953, of timely protection in the two flight seasons by stem washing with insecticide formulations obviously has halted the damage.

Green Bug

65. The incidence of green bug was in general low and was restricted to a few bushes in the estate. Periodic observations were made on the population of the green bug and the indications were that during the South West Monsoon, the entomogenous fungi reduced the pest population. With the recession of the South West Monsoon in October 1955, the activity of the entomogenous fungi slowed down, the pest infestation started and had a progression till April 1956. Later it was gradually checked by the entomogenous fungi

which were active again in the rainy weather in the months following April 1956.

Shot-Hole Borer

66. Shot-hole borer infestation was low and nearly 50 per cent less than the previous year. Monthly observations made on the incidence of the pest showed that the infestation increased from August to January and thereafter decreased upto July.

Pests in the Nursery

67. Leaf roller (*Homona sp.*), Semilooper, Cutworms and Hoppers (*Orthoptera*) were noticed in small numbers on young plants in the nursery.

Chethalli

68. Leaf disease at the Coffee Research Sub-Station was surprisingly mild throughout the year. The older plants showed signs of incipient attack of rust in early April but there was no alarming spread. The usual two sprays in the year followed by a tip spray in November to older plants and young strugglers helped in halting the spread and excessive development of the disease. There was also an appreciable carry-over of healthy leaves throughout the season.

69. The estate was particularly free from black-rot and other minor diseases.

70. The programme of chemical control in strict association with field sanitation measures of rigid tracing and removal of infested plants continued to give dividends. There was a further reduction of borer infested plants to 1,001 from 1,430 in the previous year. The incidence of green bug was negligible and was only noticed on a few stray plants, especially in the old areas. It was effectively controlled. There was no noticeable attack of other major or minor pests.

GENERAL

71. Both the stations continued to be members of the U.P.A.S.I. and the Regional Planters' Associations. The sub-station was a member of the Coorg Orange Growers' Co-operative Society also.

72. Labour strength at Balehonnur which was 156 at the end of last year, rose to 168 at the beginning of the year and closed with 164 against a sanctioned strength of 170. The average labour turn-out was 81.01 per cent against the previous year's average of 72.5 per cent. At Chethalli, the year started with 90 on the check-roll and closed with 110 against the sanctioned strength of 130. The average turn-out was 89.89 per cent against 75 per cent during most part of previous year. Labour-employer relationship continued to be cordial and happy both at Balehonnur and Chethalli.

Health and Medical Facilities

73. Health of the staff and labour was good throughout the year as reflected in the increased daily turn-out of labour. Medical facilities were provided by part-time services of the local medical officers of the Mysore and Coorg State administrations. Local anti-malarial squads attended to D.D.T. spraying of all estate quarters at both stations.

74. Dispensaries were run to issue stock medicines as prescribed by the Visiting Doctors. A sum of Rs 3,589-6-0 at Balehonnur, and Rs 1,232-3-0 at Chethalli, were spent on this account inclusive of maternity allowance. A contribution of Rs 1,740 on the basis of Rs 15 per acre was paid towards the establishment of a Group Hospital at Chethalli (Coorg). The annual contribution will be at Rs 5 per acre and this institute will in future serve the sub-station both as a Group Hospital and Estate Hospital.

HARVEST

75. The yield of uncured coffee harvested during the year is:

	Yield of coffee in bushels (uncured)				
	BALEHONNUR			CHETHALLI	
	Arabica	Robusta	Tree Coffee	Arabica	Robusta
A. Parchment	926	395	—	877½	—
B. Cherry	733	472½	107½	228	142¾
C. Gleanings and Bits	147½	65¾		78	—
D. Others	144½	71¼	¼	190	4¾
Total	1951	1004½	107¾	1373½	147½
This resulted in a yield of clean coffee of Tons	18	10.5		14	0.75
Totalling Tons	28.5 tons			14.75 tons	

Area—Replanting and New Clearing

76. The area under coffee in the two stations are:

	Planted area (in acres)		Bearing Area (in acres)	
	Arabica	Rob.	Arabica	Rob.
Balehonnur	106.62	23.75	76.75	16.25
Chethalli	106.50	8.00	89.00	1.75

77. Estimated yield of clean coffee for 1956/57 is 24.5 tons in Balehonnur and 23.5 tons in Chethalli.

78. In pursuance of the policy of replanting old un-economical and pest ridden coffee at the Coffee Research Station, Balehonnur, two acres of old coffee were uprooted for a new manurial trial and one acre was reserved for interlining old coffee with young coffee in 1956/57. An area of about 8 acres jungle was cleared for planting with world collections, Station crosses and self-bred progeny, and for cultural trials on Arabica and Robusta and for the Brazilian method of planting.

79. At Chethalli, 13.60 acres of new clearings were planted with Arabica selections. Of this, 11.1 acres were marked out for a study of comparative suitability and compatibility of common shade for coffee with a combination of 10 varieties of shade plants. An area of 6.1 acres of jungle were cleared during the year for planting in 1956/57. 5.57 acres of this area is proposed to be utilized for a single variety shade experiment with 4 replications for 10 varieties of shade plants.

Seed and Seedling Supply

80. The zonal seed plots on private estates were continued to meet the increasing demand for seeds of Station selections. 12 planters in Mysore zones, 6 in Coorg, 3 in Shevaroys and 1 in Nilgiri-Wynaad co-operated in the establishment of these seed plots. Seed coffee was prepared under the supervision of the Botanist. 7,060 lb. of Arabica and 430 lb. of Robusta coffee seeds were collected from these blocks for distribution. 3,609 lb. of Arabica and 923 lb. of Robusta and 27 lb. of Excelsa coffee seeds were prepared at the two Research Stations for supply to indentors. Seed coffee of 10,669 lb. of Arabica selections, 1,353 lb. of Robusta and 27 lb. of Excelsa were supplied to coffee growers from the two Research Stations and the Liaison zones against 5,421 lb., 877 lb. and 39 lb. respectively in the previous year. The demand for seed of Station selections continued to show an ever increasing trend and all effort was made to supply a major portion of the demand.

81. To satisfy repeated representations from peasant planters, seedling Regional Nurseries were revived and established in private estates in the different Liaison zones. 1,20,000 seedlings of Arabica selections and 27,000 seedlings of Robusta are expected to be available for sale. In addition, 50,000 basket plants and 2,000 bed plants were raised at Balehonnur, and 10,000 basket plants and 1,000 bed plants were raised at Chethalli for estate requirements and supply to local planters.

Miscellaneous Crops

Paddy

82. Paddy was grown on 1.67 acres at Balehonnur and 6.0 acres at Chethalli. Effort was made to follow up as closely as possible the Japanese method of cultivation. The following quantities of grain and straw were obtained. It was the highest on record for Chethalli being three times the average for the preceding years 1950/51 to 1954/55.

	Area Acres	*Grain lb.*	*Straw lb.*
Balehonnur	1.67	4100	5100
Chethalli	6.00	15890	9000

The yield showed a cent per cent increase over previous years at both the Stations as a result of adopting the Japanese technique again this year and a very favourable seasonal condition.

Orange

83. The orange crop at Chethalli did not belie our earlier estimates and returned a yield of more than 30 per cent over the quinquennial average. Rs. 7,701 were realised against Rs. 675 in the previous year. The prospects for the coming year continue to be encouraging and an equal, if not a better crop is expected.

Others

84. A small quantity of 28 lb. of pepper was picked at Balehonnur. Specimen plots of green manure and new shade plants were raised at the Stations for supply of seeds to estates and for observational studies.

General Amenities

85. The two Stations continued to have their own arrangements for water supply. A generator was in service at Balehonnur for supply of electric power and light. Arrangements are well advanced for securing supply of bulk power from the Electricity Department of the Government of Mysore, for electric power and light at the Coffee Research Station, Balehonnur, and to supply power and light to the Coffee Research Sub-station, Chethalli, by putting in service the generator to be released at the main Research Station.

86. A canteen was being run at Balehonnur for the benefit of the mazdoors. A suitable building is under construction. The creche for children at Chethalli continues to work. Milk for babies and mid-day meal for non-working children were provided. A radio was working at each of the Stations. Screening of films of technological and rural interest was arranged for the benefit of the staff and the mazdoors and four such expositions were held during the year. Services of the Dunlop cart was provided for conveying the school-going children at the Coffee Research Sub-station, Chethalli, to the Higher Elementary School at the 10th mile—a distance of 1 mile from the Station.

Acknowledgements

87. It is my privilege and pleasant duty to express my deep sense of gratitude and that of all members of the Research Department to the many planters who have so generously co-operated in the lay out of various field trials and demonstration plots and given unstinted help in so generous a measure. I would in particular extend our grateful thanks to Messrs. S. N. Ramanna, R. Radcliffe, F. G. Foster, C. Primrose, M. C. Mathew, M. K. Jinachandran, K. M. Verghese Mapillai, U. K. Lakshman Gowda, W. Woodbridge, K. A. Aiyapa, G. M. Manjanathaya, J. L. Short and Col. W. A. Rahm.

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89. To many scientists in India and abroad who exchanged publications and material, I am deeply grateful. It is with gratification and pleasure I record the very happy associations with many technological institutions and the Departments of Agriculture in Mysore, Coorg and Madras and their technical, technological and demonstrational divisions in particular.

It is my privilege and pleasant duty to express a deep sense of gratitude of myself and the members of Entomology Division of the Research Department to the Director and members of staff of the Commonwealth Institute of Entomology, London, who were generous in identifying the insect specimens sent from the Research Department from time to time.

90. To various proprietary and other firms who co-operated in the conduct of field trials, I am beholden.

91. I and my colleagues record with gratitude the kindness and consideration we have received from the members of the various committees and the Coffee Board. To the members of the Research Committee, I am particularly indebted. Their support and consideration has encouraged my work.

92. I am deeply grateful to Sri K. Srinivasan, Chairman, Coffee Board, for his kindness and consideration and the unfailing interest and the valuable guidance he has extended to me and the Department.

93. To the planting community who have willingly placed at the disposal of the Department their knowledge and enthused us in the solution of their many problems and for their traditional generosity, hospitality and consideration to myself and every individual member of the staff alike, I extend my deep sense of appreciation and gratitude.

94. To the various grades of technical, executive and ministerial services at the two Research Stations and the Liaison divisions, I cannot be sufficiently grateful. They have borne cheerfully the brunt of the burden by their unstinted hard work and ever willing co-operation.

95. A brief review of the work done in the different Liaison and Technological divisions together with the Sectional reports is given in the following pages.

B. T. NARAYANAN
Director of Research

PART II

EXTENSION SERVICE

During the year an independent and separate Liaison circle was instituted at Coimbatore to cover the areas in Pulneys, Anamallais, Nilgiris, Nelliampathies and other coffee areas in Travancore-Cochin State which, on account of the peculiar conditions obtaining in these areas, demanded such an early assignment. It was also felt necessary that a senior officer with experience should be posted to this problem area. Sri T. V. Pattabhiraman, the Senior Liaison Officer, was posted to this circle in October 1955. Sri. R. Vijaendraswamy, who completed his training during this period, was placed in independent charge of the South Coorg Division. There was no change in the personnel of the other divisions.

2. I toured in the Liaison divisions of Mysore, Coorg, and, Shevaroys and Nilgiris in the Madras State contacting 59 big and over 120 small planters. Advantage was taken of these visits to contact groups of planters and discuss zonal problems with them; particular emphasis was laid during these discussions on systematic cultivation and a re-orientation of techniques suited to the locality. Their co-operation was also invited in their practising these improved techniques under the advice of the local Liaison Officer. Opportunity was also taken to impress upon the planting community the necessity for replanting and rejuvenating their plantations and the possibility of so doing to pedigree material with the assistance of the Department.

3. These contacts with planters had very happy reciprocal results. In many cases, especially in Pulneys and parts of less advanced areas of Wynaad and others, it was possible to establish large-scale re-orientated cultural practices with the active co-operation of the planter himself. It was possible also to invoke active interest of many of these in the demonstration of improved methods of cultivation that was being shown on selected plots in their zone, resulting in increased number of composite cultural demonstration plots, and the adoption by an appreciable number of several of the recommended measures.

4. The year saw planters, especially the small holders, either in groups or individually, come to both the Research Stations.

5. The encouraging response to the presence of the Liaison officers in the several plantation districts noticed during last year continued to be generously extended as reflected in the rising tempo of advisory correspondence demanded from the Directorate, the Liaison divisions and the associated technical sections. Over 10,000 advisory notes were issued from the main and substations being an increase of over 40 per cent on that of last year. The Liaison divisions themselves issued over 5,000 advisory letters.

6. A brief review of the work done in the several Liaison divisions is presented in the following paragraphs:

Coimbatore Liaison Circle

7. Sri T. V. Pattabhiraman was in charge of the newly formed Coimbatore Liaison circle, from October 1956. This circle comprised of Nilgiris (Plateau), Anamallais, Pulneys, Nelliampathies and the other scattered coffee areas in Travancore-Cochin. He also held supervisory charge of Wynaad and Shevaroys Liaison divisions during the above period.

8. He was on tour for 198 days and visited 401 estates contacting 500 growers. Over 300 peasant growers were contacted either individually or in groups during these visits. 783 letters were received and answered mainly on advisory work pertaining to problems on re-orientation of cultural practices, rehabilitation and plant protection.

Upgrading of crop production

9. Pulneys and East Nilgiris, as stated in the earlier report, presented peculiar problems of soil, micro-climatic seasonal conditions which necessitated a re-orientation of cultural, protective and manurial calendar of operations, different from that obtaining in the S.W. monsoon zones. The fact that coffee in Pulneys is grown as a mixed crop with plantains taking a major share of attention, had also to be contained and revised. Rainfall throughout the year added to the problem of effective disease control.

10. Large-scale demonstrations of shifting the time schedule of manuring and spraying set up in two estates two years ago has begun to yield convincing dividends, increases in crop being over 300 per cent in successive years. This has resulted in over 30 estates of peasant farmers in the neighbourhood taking to these improved practices.

11. Gradual replacement of the existing disease susceptible uneconomic and marginal coffee is being pursued. Six varietal trials were laid down on private estates to find out the variety best suited for the locality.

12. Demonstration and exploratory trials were extended to nine estates in Pulneys and six estates in Nilgiris. A field manurial trial was in progress at Maruvahulla in Kotagiri. This zone is peculiarly suited for laying down large-scale demonstrations and the department is deeply indebted to the enthusiastic and enterprising planting community for undertaking these experiments as part of their estate operations.

13. Anamallais, Talliar and Nelliampathies, though predominantly subject to S. W. monsoon rains, again present a special problem in that these receive an appreciable amount of the rains during the N.E. monsoon. Moreover, these are areas principally of large holdings and of advanced management. Nevertheless, some re-orientation of the empirical practices now in operation seemed desirable to get a maximum return of undoubtedly good husbandry. Two trials have been started on composite blocks of 15 and 10 acres during the year in Anamallais.

14. Coffee, mostly robusta, is grown all over Travancore from almost sea-level upto 2,000 ft. elevation. These are generally small holdings grown more or less as garden plants behind houses. The general condition is not satisfactory and it is possible that both unsuitability of elevation and unsatisfactory working may be the contributing factors. The main taluks growing coffee are Thodupuzha, Muvattupuzha, Palai, Barananganam, Kottayam, Erattupetta, Ponkunnam, Peermed and Vandiperiyar.

Chikmagalur Liaison Division

15. Sri G. I. D'Souza continued to be in charge of this division. During this year nearly 125 new contacts were made mostly in the smaller groups below the acreage of 10, specially in the villages of Mel-hulvathi, Byravally and Anoor. 230 days were spent on tour during the year. 809 inward letters were received and 746 outward letters disposed off.

16. The Liaison officer attended 3 Planters' meetings at Chikmagalur and addressed 12 regional meetings in the villages of Mallandur and Attigundi in connection with the economics of small-scale cultivation of '*Mane hithlus*' along intensive lines and the need for co-operative efforts in the fields of pulping

and spraying. An equal number of group discussions were organised on the demonstration blocks in the division. Contacts with bigger units were limited to a routine visit to treat and observe the Field manurial trial blocks, to study and investigate pest and disease problems of new origin and to advisory visits at the specific request of planters.

17. The number of demonstration blocks were increased from 6 to 8, two more blocks having been opened in Joldal and Mallandur. These blocks have now attained full-fledged status as centres for propaganda in methods of intensification specially at the lower acreage levels. Demonstrations in the control of Green bug with the aid of chemical sprays were organised on the demonstration blocks with the active co-operation of Messrs Chika Ltd., Bangalore. One ton of a 60-30-40 fertilizer mixture donated by the Mysore Fertilizer Co., Madras, was distributed among 5 demonstration blocks. The acreage under demonstration on each of the blocks has been extended from $\frac{1}{2}$ acre to 2 acres. On the demonstration blocks at Jaknally, Attigundi and Hospet, the results in improvement are convincing in as much as the crop estimated on these blocks during the season is not less than 4 cwt. per acre.

18. Organization of a co-operative pulping unit at Mallandur was a new venture in extension. To enable the small growers convert their cherry into parchment and benefit from the increased returns, a co-operative society was organised, and a demonstration in co-operative pulping carried out. A sum of Rs 580 has been subscribed as share capital of the Society. A sum of Rs 416-12-0 was realised as pulping charges during a period of 21 days of which Rs 157-4-0 accrued as a nett profit to the Society. The demonstration also served as a useful source of propaganda for increasing the output of parchment coffee from the Mallandur area. Four big growers in Mallandur established their own pulpers during this demonstration period. Organization and initiation of Co-operative bodies is being continued. Towards the close of the year representations to help small growers organise into co-operative bodies were received from the villages of Anoor, Osallypet, Attigundi and Dasarahally. The work of organization has been taken up at Anoor and Osallypet.

Field Manurial trials

19. Besides attending to manurial treatment during the post-monsoon, pre-blossom and post-blossom periods on the manurial trial blocks at Bynecool and Togarihankal estates, routine visits were paid to these two blocks to study and observe any differential response in each of the sub-plots.

Pests and diseases

20. **Coffee Stem borer:** Propaganda work directed at rigorous removal and destruction of affected material followed up by B.H.C. applications during the flight periods was continued. A tendency to persist with borer affected bushes and place all reliance on B.H.C. alone to give economic control was discouraged as it runs contra to the provisions of the Pest Act governing this insect pest. In spite of a prolonged drought on the eastern Giris which are generally endemic to this pest, the incidence has been very low in estates which had practised rigorous control measures. The incidence has been as low as one per acre on Bynecool estate as compared to 80 per acre during 1954, and about 15 per acre on Togarihankal against 200 per acre for the year 1954. In the other ranges of the division, this pest has not been a serious problem.

21. **Leaf disease:** A severe infestation on an epidemic scale occurred during the wet period—July to September on most ranges. As a result, there was a certain amount of loss in standing crop and new wood. A feature of

well-cultivated estates has been the quick and satisfactory recovery made by the affected bushes during the post-monsoon period.

22. **Die-back:** Apart from die-back of bearing and new-wood consequent on attacks by leaf disease, a case of summer die-back due to causes unknown was investigated on a 2-year old new clearing on Kathlekhan estate. Control measures along similar lines adopted in an identical case last year on Santaveri were recommended. The causative organism could not be isolated.

23. **Root-rot:** A condition of root-rot reported from Santaveri estate, affecting bushes above the age of about 25 years and causing an annual loss of about 10 bushes per acre has been taken up for study during March 1956. Pending isolation of the fungus only indirect measures of control have been formulated.

24. **Collar-rot in nursery:** Severe losses caused during the year 1955 were staved off during this year by adoption of timely sanitary and prophylactic measures.

25. **Chlorosis:** A yellowing of foliage of mature coffee on Thippanahally estate has been taken for investigation during May 1956. Preliminary trials with foliar sprays and stem injections with solutions of the trace elements Boron, Iron, and Zinc were conducted.

Mudigere Liaison Division

26. Sri H. S. Puttuswamy continued to be in charge of this Division. During the period under report, 738 letters were despatched and about an equal number received. 253 days were spent on tour and 563 planters were contacted.

27. An encouraging sign of the period under review has been the steady increase in the number of requests made in connection with such questions as control of pests and diseases of coffee, cultivation problems, manurial, soil conservation and nursery practices. During the period under report, 140 new contacts were established mostly in the smaller groups. Advisory work done on small holdings was always followed by demonstrations. This created more enthusiasm in the adopting of new methods advocated, among small planters. Special attention was paid to problem areas and every assistance was given to owners and managers in bringing the pests and diseases under control and also checking their further spread.

28. The number of demonstration blocks were increased from five to eight, a new block being opened at Gullenpet, another at Kaskebylu and the third at Hirebile. These demonstrations helped to spread the improved methods of cultural practices among the small holders who form the major portion of the planting industry in this division. The acreage under each demonstration block has to be small from ½ acre to 1 acre in as much as the holding of the farmer himself is limited. These are being extended to a minimum of 2 acres each. On the demonstration blocks at Kaduvalli, Nandipura, Palguni, Bidarahally and Yellikodige, the results in improvement are becoming evident. The crop on blossom is estimated at 7 cwt. per acre on Kaduvalli block, 4 cwt. on Palguni and Bidarahally blocks, 3 cwt. on Yellikodige and Nandipura blocks. Improvement in the general appearance, spread and vigour of coffee is a pleasing feature. Every assistance was received not only from small planters on whose plots demonstration is laid out but also from neighbouring big planters. These visual responses have evoked enquiry from numerous small planters and a desire to repeat similar practices on their own estates.

29. In addition to estate visits, discussions were also held at various small planters' organizations. This has helped to disseminate a wider knowledge

and establish a better understanding of the work of the Research Department and planting practices have been progressively influenced in this way. Ten such meetings were addressed during the period under report.

Exhibitions and conference

30. The Department took part in the Exhibition organized by the National Extension Scheme, Mudigere, from 10th to 17th February 1956. Charts, live plant material, seed coffee from different selections and manure samples were exhibited. A coffee conference was held on the 15th February. Various problems regarding the welfare of coffee industry were discussed in the conference.

Field experiments

31. Two modified robusta manurial experiments were started at Uggehally and Banakal estates during 1956. In addition, three experiments on the control of Coffee Stem Borer were started at Bettadamane, Chandrapore and Baskal estates for comparison of relative efficacy of some of the pesticides. Thanks are also due to these planters who gladly co-operated and placed facilities at the disposal of the Department to carry out the experiments.

Pests and diseases

32. The Coffee stem borer still remains a baffling problem in Aldur and Gonibeed areas. Elsewhere it is not a serious problem. A concentrated campaign has been started in Aldur and Gonibeed and Kalasa areas to bring the borer under control by intensive propaganda by persuading the planters, particularly small holders, to take up rigorous control measures during preflight and flight seasons—tracing, uprooting and burning of the affected trees followed by B.H.C. swabbing. The response to this propaganda is very encouraging. Incidence in several estates has been reduced by over 50 per cent.

33. Attacks of shot hole borer on robusta have been unusually severe in parts of Mudigere, Banakal and Balehonnur areas. Since the use of insecticides against this pest is at present impracticable, rigorous propaganda has been launched during the year to persuade planters to take up control measures like pruning and burning of all the affected twigs all round the year, adequate manuring, thinning of shade and attention to proper drainage.

34. Leaf disease was prevalent during Aug-Sept. in Aldur area, but a marked recovery had occurred by the end of November. It was noticed that the recovery had been quick on well managed estates.

35. A periodical assessment of the pest and disease position in the zone formed part of the routine duties to enable issue of advisory and cautionary notices.

Saklespur Liaison Division

36. Sri W. Raghavendra Rao continued in charge of the Division. 280 days were spent on tour contacting 572 planters and visiting 400 estates of which over 70 per cent were small holdings. 28 planters' gatherings were addressed to emphasize on pest control and adequate feeding of plants in an area where the problem was one of upgrading small holdings which formed the majority of plantations in the zone, by contending against the coffee stem borer on the one hand and a devastating type of leaf disease on the other, which ran through the coffee in most years. The noticeable decrease in the incidence of coffee stem borer on both large and small holdings, reflected directly the result of these efforts and visual demonstrations of both field sanitation and chemical control methods. With the initiation of an effective measure of control of this pest, it has been possible in a few cases to reduce the number of applications

of the pesticide to the long flight season, thus effecting considerable saving in labour and material. A further step was taken to induce the planters to adopt a judicious and even generous application of manures and fertilizers.

37. Uneconomic, non-bearing hybrid plants formed a chief drag in many estates of this zone. Two-way attack to improve this unhappy situation was undertaken. Successful grafting of robusta stock with arabica scions has caught the attention of many planters and quite a few are resorting to this method. Again in mixed areas of robusta and arabica, there has been a gradual and noticeable move to remove robusta and replant to pedigree arabica plants.

38. The comparative good performance of arabica coffee in many demonstration, varietal and established Station selection plots seems to have halted the tendency to plant robusta indiscriminately. There is a noticeable tendency to replant to arabica as evidenced by the demand for seed material.

39. The number of composite demonstration plots was increased from 4 in 1954-55 to 8 during the year. The work consisted of drawing up of a suitable calendar of operations, laying stress on the timely conduct of the various cultural operations, adequate feeding of the bushes with balanced fertilizers and taking up of suitable control measures against pests and diseases and the execution of the above schedule under the initiative and guidance of the Liaison Officer. These are the centres of intensive departmental activity since practical demonstrations of all the measures considered essential for toning up of the yields has been the key note of the departmental effort. Satisfactory results are already in evidence in the blocks where one year's full work has been done. It is considered that with another two years' working, the blocks may be brought to the 4 to 5 cwt. yield level.

40. Field manurial trials on the optimum requirement of plant foods for arabica and robusta and a plot trial on the effect of varying doses of nitrogen on yield of arabica were in progress.

41. Three exploratory trials to define a cheap and effective insecticide against borer and four varietal trials of station selections to define suitability of plant material to the zone were in progress. An assay of yield and response to soil micro climate, pest and disease position of Station selections issued and established in this area formed an important work of this period.

North Coorg Liaison Division, Somwarpet

42. Sri K. T. Bhagat continued to be in charge of this division. 276 days were spent on tour contacting 440 planters and 250 estates were visited, inclusive of group visits to small holdings. Planters' meetings were addressed at Somwarpet, Sanivarasanthe and Murnad.

43. As stated in the earlier report, the problem in this zone of a highly advanced planting community which anticipates improvements in cultural techniques, was one of prompt attention to local and long-term problems, particularly in pest control, soil amendments and effective shade formation. Over 1,200 letters were received and 1,000 letters were despatched in advisory correspondence.

44. **Group discussions:** One of the main features of the Liaison work in this division was the group visits to small estates. Group discussions were held at village centres and all important aspects of coffee cultivation were dealt with. The centres visited for this purpose were:

1. Sanivarasanthe—Bidrur-Gopalpur-Santveri-Bedagota.
2. Somwarpet—Thalthara-Settalli-Shanthalli-Negalle-karkalle.
3. Murnad—Icola-Kiggal.
4. Aruvathoklu village—Bettagere.
5. Suntikoppa—Horoor-Boickere.

45. The field manurial trial laid out in the earlier year at Malamby in Sanivarasanthe—a comparatively less advanced area—was continued. Signs were just visible of the effectiveness of timely and adequate applications especially of nitrogen in this zone.

46. During the period under report two more demonstration plots were freshly laid out, bringing the total demonstration plots in the zone to six. These have been laid out in representative areas of Somwarpet and Mercara zones, in small holders' estates to demonstrate scientific methods of cultivation. It is interesting to note that all the six demonstration plots have shown a great improvement over their previous condition. The visible signs of improvement have attracted the attention of growers round about and enthused them to follow these methods.

47. As a special feature, importance was stressed during the year, on the correct method of raising seedlings and their care in the nursery. In Sanivarasanthe zone, a few composite nurseries were organised where groups of small growers joined to raise a common nursery as recommended by the Department.

48. The damages due to pests and diseases was very much less in the demonstration plots and they were practically free from leaf disease.

South Coorg Liaison Division, Chethalli

49. Sri R. Vijaendraswamy was posted early in October 1955, to this division. He was on tour for 91 days for contacting planters, assaying needs and studying local problems. 72 estates were visited and 94 planters were contacted. The area extends over 26,646 acres of which 19,098 acres are cropped to robusta and 7,546 to arabica. It is interesting that more than 50 per cent of this acreage is covered by large holdings of more than 100 acres each. The small holdings below 5 acres, constituting more than 80 per cent of the total holdings, account for less than 12 per cent of the total acreage.

50. As in the case of North Coorg, this area also comprises of some of the most advanced estates in the coffee industry. The problem here again, was one of prompt attention to local and long-term problems specially land management with particular reference to shade regulation. Moreover the area is largely cropped to robusta, one fourth of the area only being grown with arabica.

51. There are, however, small pockets of comparatively under-developed areas in and around Virajpet, Ponnampet, Napoklu and Srimangala which require attention and primary advisory information. 424 advisory letters were issued during the period.

52. Again as a first step in invoking crop consciousness, eight demonstration plots have been laid down in representative easily accessible areas on systematic cultural practices suited to the area. Two field manurial trials, one exploratory trial on the relative efficacy of chloro-aromatic compounds and four varietal trials were also in progress.

Nilgiri-Malabar Wynaad Liaison Division, Kalpetta

53. Sri S. J. Mathias continued to be in charge of the Division. 265 days were spent on tour of visits to experimental blocks, problem areas and to meet planters and planters' associations. 486 estates were visited and over 200 new contacts established. 55 meetings with groups of planters and Planters' Associations were attended.

54. The major problem of this area continued to be of finding ways and means to upgrade production which in spite of natural advantages has been one of the lowest for the variety of crop grown. The first step in this direction was the simple technique of regularizing and reorienting cultural practices which

were neither scientific nor useful. In some cases, established practices were actually harmful.

55. The majority of growers had been persuaded to give up monsoon digging, heavy pruning and intercropping with open crops and instead, operations like light handling, summer scuffling, thinning of shade before the commencement of the monsoons, manuring with balanced fertilizers and renovation trenching were introduced. The results so far have been encouraging; for, the coffee in the Wynaad during the last three years has been cropping steadily at a record level of over 3,000 tons as against the marked fluctuations of former years, and the tendency is for a gradual increase in years to come.

56. The programme of upgrading production started in 1954-55 was continued on a wider scale. Besides exploratory work on the manurial requirements of robusta and the efficacy of insecticides on the control of Coffee stem borer on arabica, composite demonstration trial blocks were opened up on private holdings to show practically the benefits of scientific coffee culture. With these as visual guides, the contacting of a large body of growers and attending to their specific problems were pursued.

57. The number of demonstration trial plots was increased from 4 in 1954-55 to 8 during the year. The four blocks which had received a year's treatment had registered remarkable improvements and the crops doubled. The following crops were harvested from the four demonstration plots.

1. 2½ cwt. over the 50 cents under demonstration in Mundari Wodiyar's estate.
2. 2 cwt. 30 lb. over 50 cents under demonstration in Kunnoth estates.
3. 2 cwt. over the 50 cents under demonstration in Jayagiri estates and
4. 1¾ cwt. over 50 cents under demonstration in Lower Devamalai estate.

With the consent of the owners, the treatments are being extended to two acres in each block.

58. Besides the four robusta manurial trials started during the previous year, two new modified manurial trials on robusta were opened up on (1) Maniyangode estate, Kalpetta, and (2) Panchora estate, Nellakotta. Also an experiment to find out the efficacy of different pesticides for the control of Coffee stem borer of arabica was started at Rockwood estate, Nellakotta.

Pests and diseases

59. In Malabar-Wynaad where practically only robusta is grown, the only pest to reckon with is the shot hole borer (*Xyleborus morsttati*). Since the last outbreak of this pest in 1954-55, it has been well kept down and the present intensity is about 1 per cent infection. This lowering of the incidence of this pest could be attributed to the adoption generally of thinning of shade before monsoon, pruning and burning of the affected twigs, manuring and regular and timely weedings as recommended and demonstrated by the Department.

60. In Nilgiri-Wynaad, leaf disease on arabica was comparatively mild. The majority of growers had taken up to Bordeaux spraying and many had begun systematic manuring.

61. **Coffee stem borer:** The small growers of this tract have not been uprooting the borer affected bushes until the plants are dead. Application of B.H.C. during the flight seasons and the removal and burning of moribund plants were demonstrated where tracing and removal were not favoured. In Gudalur village, the majority of small growers had adopted this method of controlling borer.

62. A further step was taken in reintroducing arabica into this area. 283 acres had been planted to arabica against no arabica in 1953-54. Their performance so far was so encouraging that there was a noticeable demand for arabica seed not only for new clearings but to replant moribund, uneconomic and old robusta areas.

Shevaroys Liaison Division, Yercaud

63. Sri B. K. Chandrappa continued to be in charge of the Shevaroys Liaison division. 257 days were spent on tour visiting 335 estates of all categories and contacting 580 growers which were mostly renewals. More than 20 group meetings of planters were held in villages with small planters.

64. The area is situated in the North East monsoon zone and demands a readjustment in the timing of many of the routine essential cultural, protective and manurial operations practised in the established coffee areas of the S. W. monsoon zones. The problem, though similar to East Nilgiris, was again distinct and different because of the long spells of dry weather.

65. The meetings with groups of planters helped in re-orientation of cultural practices, especially plant protection, with special reference to timing, and an awakened interest in proper and adequate manuring. The results are encouraging in that the returns from both small and big estates show definite signs of improvement varying from 20 to as high as 70 per cent in some cases.

66. The composite demonstration plots which were laid down in this behalf in the earlier year were showing definite signs of benefiting by these changes and evoked active interest from neighbouring planters. These were extended to another four during the year in new areas.

67. Shade management is one of the major problems of this area. There has been a tendency for over shading—inclusive of thick shading by growing too many shade plants—that often vitiates any improvement on account of feeding or protection. An exploratory trial was therefore laid down to study the effect of thinning of shade with applications of stipulated doses of fertilizer, spraying and standard cultural practices germane to coffee. The experiment which was laid out on 2.5 acres in the first instance has been extended to 10 acres with the active co-operation of the owner of the estate.

68. An observational study on the influence of 3 intensities of shade on growth and yield was started during the year.

69. Observational studies on plant suitability with special reference to the 10 varieties of Station Selections now under issue and growing in the Shevaroys were continued. S.795, S.953 and S.645 seem to be the most promising of the varieties under study as regards both growth and yield. S.910 and S.518, though of good growth and fairly high yield, seem to have an abnormally high triage. Further observations are in progress.

PART III

RESEARCH

AGRONOMY

Trials started earlier on the influence of different cultural practices on yield of coffee, cultivation methods, management operations and manuring of Robusta and pruning were continued. Studies on the retention of berries on station selections were repeated as also those on viability of germination of Arabica seeds.

The experiment on different agronomical practices—digging, pruning, weeding and manuring at different times, forms and grades was concluded. Indications are that complete fertilizer N40:P30:K40 in September/October, slash weeding in July and deep digging in August give higher yields than other treatments.

The experiments on soil cultivation methods—trenching, renovation pitting and deep and light digging and soil management operations with various grades of digging during different seasons are in the second year of study and no significant results have as yet been obtained. The initial trends are that different types of trenching and light digging in November may produce better yields.

Three experiments on manuring of Robusta coffee with and without pruning have been in the fourth year of study and the indications so far are that increased yield resulted with N:P:K at 40:30:40 and the higher 80:30:40 rate was inferior to this. The results from the latest yield data have shown slight variations, the 80:30:40 manured plots coming highest in one experiment, 40:30:40 with pruning yielding best in the other two.

Observations on the setting of berries and the final harvest in relation to the number of flowers produced have been in progress since three years. A confirmation of earlier findings that retention of berries to the ripening stage was in direct proportion to the amount of leaf carried by the branch was obtained.

Observations on the berry-retention in the different Arabica selections S.288, S.333, S.645, S.795 and Kents were done in the 1955-56 crop season and S.645 was found to carry the largest percentage of berries to ripening, and Kents the lowest. The study is being repeated.

In studies on the viability of germination of seeds, the same results as in the previous years were again obtained. Seeds sown with their parchment cover split or removed germinated 10-15 days earlier than those with parchment covers intact. There was an indication that germination may be less in the case of stored seeds, and ashing or such similar treatments in the preparation of the seed may have little or no effect on germination.

In a study on the effect of topping Robusta plants at a lower and a higher level started four years back, it was observed in the first three years that better growth of primary branches resulted by topping at the lower height (3′). The latest data shows that the plants topped at the higher level (4′) have grown more vigorously than the others and also given a higher yield.

Studies on the shade requirements of Arabica coffee have been started. A newly cleared area in the Coffee Research Sub-Station has been planted in 1955 under an experiment to find out suitable types and combination of shade trees. The experiment has been extended to compare the influence of one single

type of shade tree against the mixed shade under trial in the earlier experiment. The following trees were under examination:

1. *Ficus glomerata* (Atti)
2. *Ficus nervosa* (Malaigaragathi)
3. *Dalbergia latifolia* (Beete)
4. *Pterocarpus marsupium* (Honne)
5. *Eugenia jambolana* (Nerale)
6. *Artocarpus heterophyllus* (Jack)
7. *Ficus sp.* (Elibasari)
8. *Albizzia lebbeck* (Kalbage)
9. *Bischofia javanica* (Neeli)
10. *Ficus retusa* (Mitli)

CHEMISTRY

Field: Experiments on the manurial requirements of coffee, land management with special reference to soil and moisture conservation, influence of trace elements on growth and health factors and studies on the processing of the crop were continued.

Under manurial experiments, the studies on the essential requirement of plant foods by application of stipulated levels of N.P.K. singly and in combination were continued and the 16th yield recorded. Application of Nitrogen and Phosphates gave the highest yield and was superior to Nitrogen only or Nitrogen and Potash or untreated control, but not to complete fertilizer. The average yield over 16 years also follows almost the same pattern. Grouping the clean coffee yields into five year periods and expressing as percentage of control, the following results are obtained:

	N	N.P.	N.K.	N.P.K.	Con.
1949—53	136.3	129.0	129.0	126.6	100
1950—54	141.8	129.1	138.0	136.7	100
1951—55	120.1	129.8	122.0	122.7	100
1952—56	112.6	130.0	112.8	120.4	100

It is observed that yield increase over control has been steady in the case of treatment with Nitrogen and Phosphate while in other treatments, there has been a gradual reduction in the yield increases though it has been the lowest in complete fertilizer.

These fundamental experiments were extended to trials on the different forms of Nitrogen, on the application of varying doses of Nitrogen from 40 to 100 lb. at rising levels of 20 lb. with a fixed dose of Phosphate and Potash, on the application of varying doses of Phosphate and Potash, with a fixed basic level of Nitrogen, and on the application of varying levels and combination of N.P. and K on specially planted plots since 1952 to enable draw a co-ordinated programme and were in progress.

Field trials to find out the maximum economic dose of Nitrogen and the role of Phosphates and Potash in balancing the Nitrogen utilization, on the effect of fertilizer mixtures containing insecticides, on the application of different sources of Nitrogen have been started in 1955-56 on mature yielding plants.

Field manurial trials with Arabica coffee started in ten estates in different soil climatic zones on the application of 40-100 lb. of Nitrogen in split doses with and without P and K are in the second year of study. The trends noticed from the first yield data show that when Nitrogen is applied at rates more than 40 lb. to the acre annually it would be profitable if applied in more than two doses. Phosphate at 30 lb. to the acre level is able to increase the beneficial effects of Nitrogen upto 80 lb. per acre and when the Nitrogen level exceeds this, more phosphate may be necessary.

Similar trials on Robusta are in progress in 5 different estates in the major Robusta growing areas.

It is well known that Robusta is by nature predisposed to vegetative growth and consequently heavy application of Nitrogen unaccompanied by proportionate increases in Phosphate and/or Potash may not produce greater crops. The earlier trials have therefore been modified and extended to 14 with emphasis on increasing doses of Phosphate and Potash relative to that of Nitrogen.

Experiments on the need for manuring seedlings in the nursery started two years ago have indicated that adequate applications of a complete fertilizer mixture promotes growth and well being of the plant. More interesting, Nitrogen in combination with Phosphate both in soluble forms applied in weekly doses produces considerable increase in growth. Of the different forms, Urea, Ammonium Sulphate, Ammonium Nitrate and Chilean Nitrate, the latter seems to hinder growth while the first named seems to be the best form, especially when adequate supplies of Phosphate are available.

Nursery trials on the use of trace elements preparations and foliar spray with Urea mentioned in the earlier report did not show any significantly better growth performance in the nursery. It was, however, interesting to observe that plants sprayed with an iron complex in Urea solution established better in the field.

Field trials on Urea spray at stipulated times gave negative results so far as yield improvements were concerned. There was, however, noticeable improvement in the well being of the plant resulting in greater effective leaf retention. This agrees with findings on other crops.

Preliminary studies on soil moisture requirements and the influence of shade on soil conditions indicate that the presence of the primary canopy is likely to result in moisture competition at critical periods of moisture requirement of the coffee plant. Observations are being continued to find out how far shade has to be regulated to effect maximum moisture conservation.

Further trials on the evolving of a suitable technique for a quick and cheap method of processing the cherry into parchment confirmed the earlier findings that treatment with defined concentrations of Caustic Soda solution accelerated the process and it was possible to complete clean washing of the coffee in less than one hour against the 24 to 36 hours required for normal digestion and fermentation. A number of plantations are adopting this technique, especially where Robusta is concerned. No untoward effect on the quality of the crop has so far been noticed.

Trials to eliminate the fruity flavour in 'cherry' coffee by pre-washing have not been successful. The trial is being repeated.

Physiological studies on the mineral composition of indicator leaves and petioles from plants, receiving different manurial treatments do not show any specific correlation to the treatments themselves, but as stated in the earlier report, specific changes in the leaf levels of the major nutrients become noticeable corresponding to the various physiological phases of the seasonal activities of the plants.

A comparative study of soils and tissues from differentially manured plots in the various coffee zones has been undertaken to define the probable timing of essential requirements of foods as it has been noticed that there may be periods of peak withdrawals of the various nutrients in the growth cycle of the plant.

BOTANY

Work on coffee breeding with reference to leaf disease resistance and high and uniform yielding qualities was continued. Cross breeding and selfing of selected plants, raising their progenies for performance tests, vegetative propagation of good bearers, comparative trials using clonal plants raised from promising materials, collection and establishment of plant material of local and foreign origin as foundation stock were in progress. Morphological and cytological studies on coffee in the laboratory were also continued.

Pure line breeding to isolate selections resistant to leaf disease and with high and even bearing qualities was extended by raising seedlings of 4th generation progeny of one Arabica culture, 2nd generation progeny of 6 Arabica cultures and F_2 and F_3 of two selections cross-bred with Coorgs and Kents arabica. Third and fourth generation of one and 2nd generation of 4 Arabica cultures as well as F_1 and F_2 of two selections cross-bred with Kents and Coorgs arabica were selfed to raise further generations for study.

Eight inter-crosses were effected among cultures of BA series and one cross was effected between a selected plant from a first selfed generation of S.795 and a selected plant from an Arabica collection from Anglo-Egyptian Sudan which appeared resistant to four established races of leaf disease. Field trials laid out earlier with inter-crosses of cultures were continued. Observations on leaf disease incidence are being made.

Inter specific crosses for exploratory trials were further pursued. Progeny of the second back-cross of Robusta X Kents Arabica with Kents Arabica planted in 1954 are so far free from leaf disease in the field. F_1 progeny of inter specific crosses involving Robusta, Liberica, Eugenoides and Excelsa were planted in trial plots. Further crosses of the progeny of the natural Robusta X Arabica hybrid (Devamachi hybrid) with Arabica selections were effected. Seedlings of earlier years' crossings planted in the field in 1954 have shown disease incidence upto 2 per cent so far.

Field studies for the isolation of best performers from the clonal progeny of 36 Arabica and 17 Robusta cultures were continued. The second crop from the Arabica and first from Robusta cultures have been harvested. The Arabica cultures continued to show resistance to leaf disease.

Morphological studies of important station selections under large-scale distribution are being made to describe them. Morphology of the 11 pairs of chromosomes in Robusta coffee was studied, and they could be grouped as long, medium and short.

Microsporogenesis in Robusta was studied and it was found to be regular. Abnormalities like failure of pairing and lagging of chromosomes resulting in abortive pollen grains were noticed in about 4 per cent of the pollen mother cells. Upto 8 per cent of the fully formed pollen grains were shrivelled and had very little starch grains.

Attempts to double the number of chromosomes in Robusta by colchicine treatments have been successful. Seedlings treated at the cotyledonary stage have coarse, thick and crinkled leaves and chromosome number $2n=44$, and are under observation.

Studies on vegetative propagation by rooting of cuttings and grafting were continued. Use of hormones for increasing the percentage of rooting of single-noded leafy sucker cuttings is being tried. Clonal progeny of selected arabica and robusta cultures are being raised for planting in trial plots. Grafting of Robusta plants in a mixed plot by the wedge-grafting technique on tender suckers using Arabica scions has been done and 90 per cent success obtained. Top-working of young Robusta plants with Arabica has been done and the grafts have produced vigorous growth while the Robusta branches also are giving

crop. Grafting demonstrations were held at the Research Stations to attending planters and their staff.

The exchange of seed material between several coffee growing areas in the world and this Station were continued. About 110 varieties of Arabica, 4 varieties of Liberica, 2 of Excelsa and Kawisari, Congensis, Stenophylla, Eugenoides, Racemosa, Salvatrix, Kapakata and Ligustroides have been established. Of the first set of 83 varieties of Arabica, only 12 are showing leaf disease resistance.

Experiments started in earlier years for comparing the performances of Robusta and Arabica grown on multiple stem (3 suckers) system and the single stem, were continued. The multiple stem plants have not given any appreciable increase in yields over single stem plants. On the other hand, the incidence of stem borer on arabica and shot hole borer on robusta multiple stem plants were more compared to single stem.

ENTOMOLOGY

Studies on the seasonal intensity of incidence of pests—Arabica Stem Borer, Robusta Shot Hole Borer, Green bug and others, and their control employing chlorinated hydrocarbons, chlorinated camphenes, organophosphorus compounds including systemic insecticides and white oil emulsions and biological control using natural parasites were continued.

Experiments on the field control of stem borer incidence in Arabica coffee using insecticides were continued and extended to comparison of the relative efficacy of B.H.C. and its formulations, combinations of B.H.C. and D.D.T., Folidol E605, Chlordane or Toxophene, Aldrin and Dieldrin, B.H.C. formulations except dust form, have given effective control consistently and are better than Chlordane or Camphene. Two applications of Dieldrin were as effective as 3 applications of B.H.C. Higher concentrations of Dieldrin had a longer lasting toxic effect but was uneconomical. Systemic insecticides at the strengths used were not effective. Further trials to assess the comparative efficacy of newer insecticides have been started and are in progress.

Trials for the control of Green bug using organophosphorus compounds including systemic insecticides and mineral oil emulsions were further pursued. Ekatox 20 (0.1 per cent) and Folidol E605 (0.02 per cent) were equally effective and better than white oil emulsion. Ekatox and Folidol at these concentrations were effective when used in Bordeaux spray. There was, however, a reduction in effectiveness, but it was less in the case of Folidol. Experiments to determine the optimum concentration of suitable insecticides for Green bug control in different seasons and localities are also continued.

Studies on the effect of insecticides on the natural parasite, Coccophagus bogoriensis KON, of Green bug have been started. The insecticides are found to affect the survival of this parasite adversely and thus reduce the parasite population except with white oil emulsion which is not toxic to Green bug adults.

Experiments on the application of systemic insecticide to localised parts of Green bug infested plants to study the absorption of the insecticides and translocation within the plants have been started. Applying the insecticides soaked in cotton and wrapped around a portion of the main stem and covered over by an impermeable film of alkathene to prevent evaporation and facilitate slow absorption, proved effective. Plants appeared to absorb the insecticides resulting in fair mortality of the bugs on the leaves and twigs. The experiment is being extended to large scale trials in different zones and conditions.

Observations on the incidence of shot hole borer on Robusta were continued. The pest was found to have overlapping broods abounding in the period between August and January.

Exploratory trials to compare insecticidal treatments with pruning for control of shot hole borer carried out in earlier years were repeated. It was observed that two applications of G1250 and B.H.C. 50 per cent at monthly intervals effectively protected plants from shot hole borer attack for a period of about 60 days from the first application in August.

In a trial to compare G1250, B.H.C. 50 per cent and Dieldrin in shot hole borer control, as a result of 2 applications at 40 days intervals in January and February, reinfestation was less in plants treated with G1250 and B.H.C. 50 per cent than in Dieldrin.

Experiments to control shot hole borer have been started using systemic insecticides applied by the 'binding' method.

In an experiment conducted to test the effects of soil amendment and other pesticidal treatments in the control of eelworm, soil amendments were found to decrease the nematode population and repeated applications of Ekatox checked the increase of the pest. Further tests have been started to find out the comparative efficacy of different soil amendments. Indications are that Calcium Cyanamide and Urea combined with Sulphur effectively arrest increase of eelworms.

MYCOLOGY

Field trials on spraying of coffee to find out efficient economic methods of control and to evaluate efficacy of various proprietary fungicides as compared with the standard Bordeaux mixture in controlling the major diseases of coffee and fundamental work on the life history and possibilities of control of the common diseases were in progress. A series of tests with low volume spray equipment were undertaken to find out if an economy in spray mixture could be effected without imparing efficacy of disease control.

Trials on effective reduction in strength of Bordeaux mixture again seem to indicate that the ½ per cent strength now in common use is still the most effective.

A number of low volume spray equipments were compared with the present standard high volume high pressure spray equipment to find if an economy in spray mixture could be effected. Though some of the low volume equipment tested effect some economy in spray mixture, these consume much more time to give an efficient coverage as compared with the present standard practice. It is observed that to get a proper under surface coverage on a dense bushy plant like coffee, a high pressure is essential to provide proper lifting force and thereby help in good penetration. The low volume equipment was found to have very little lifting force as compared with the high volume high pressure spray now in common use.

Studies on the life history of the Black rot fungus with particular reference to mode of oversummering were conducted. Successful artificial infections were obtained by keeping infected material in contact with fresh healthy tissue during favourable rainy weather, but not when done towards close of monsoon. Fallen infected material kept on the ground under healthy plants failed to carry over the disease during the dry weather and initiate fresh infections in next season. Plants showing disease during current season are the ones which exhibit the disease early in coming season also. Indications from the above observations are that the fungus tides over the unfavourable dry months by remaining as resistant sclerotia or dormant mycelia lying protected in the crevices of live infected twigs. Best control of the disease was noticed where fungicidal spray was combined with mechanical removal of diseased material and such treatments checked the spread of the disease during the rest of the monsoon.

The following plants—Rose, Mint, Jasmine, Dahlia, Bougenvillea, Lantana and Fern were also found affected with a disease similar to Black rot of coffee.

Studies on the control of Collar rot and damping off in the nursery were continued. Seed dressing materials and soil sterilization were tested. It was found that soil sterilization treatments followed by monthly Bordeaux drenches afforded good control of the disease.

Studies on Brown-eye-spot in nurseries and new clearings were continued. In trials to assess the relative susceptibility of the Arabica varieties—Kents, Coorgs, S. 795 and S. 288 to incidence of Brown-eye-spot disease under artificial and natural infection conditions, very little difference was noticed. Control of the disease by use of fungicidal sprays is under investigation.

PART IV

SECTION REPORTS

I. AGRONOMY

The main work in the Agronomy Division consisted of study of various cultural practices with reference to season, soil conditions and aspects of the area. Studies on soil moisture control and erosion control by different types of agronomic practices were also made. Observational studies on the rate of retention of fruits by coffee from the stage of blossoming to ripening as well as germination studies in arabica coffee seed also formed a part of the work.

I. Trials in Agronomy Practices

This experiment started in 1951 was continued during the year. Various cultural practices in vogue in coffee estates are tried here in combinations as well as individually. It is to see whether an optimum combination of these various practices could be evolved to suit the cultivation of arabica in this soil climatic zone. The effectiveness of the experiment is judged by the yield obtained in these treatments under varying ecological conditions of shade, depth of soil and fertility.

Yield record of the experiment is given in Appendix IV.

The treatments have not been significant. Treatment C (full fertilizer in April-May, soil stirring in Oct.-Nov., slash weeding in July and deep digging in August) gave the highest numerical yield.

Indications are that in three out of four years, full fertilizer in September-October produced higher yields. Slash weeding in July was the best in all the four years. Deep digging in August also produced higher yields in three out of four years.

This experiment has been discontinued.

II. Studies on the influence of varying practices of soil cultivation on yield of Arabica coffee

(a) Soil cultivation experiment—Coffee Research Station, Balehonnur:

This trial started in June 1954 was continued. Different methods of soil cultivation such as trenching, renovation pitting, deep and light digging were compared against 'no treatment' (weeding only). The yield data of the experiment is given in Appendix V.

The present year's data has not shown significant differences between individual treatments. But treatments getting two types of trenching as well as renovation pitting have come at the top of the list. The experiment is in progress.

(b) Soil management experiment—Coffee Research Station, Balehonnur:

This experiment commenced in July 1954 was continued during the present year. The aim of the experiment is to study the various grades of cultivation during different seasons and to see their effect on the yield of coffee.

Details of treatments and yield data are given in Appendix VI.

The treatments have not been significant. Treatment D (light digging in November) has, however, produced numerically the highest yield followed by treatment B (light digging in August). The experiment is in progress.

III. Manurial experiments on robusta—Influence of varying levels of nitrogen with fixed application of P & K on yield of coffee

This experiment which was laid out in 1951 at the Coffee Research Station, Balehonnur, was continued.

The experiment aims to study the effect of applying complete manure to robusta with two varying nitrogen levels of 40 lb. and 80 lb. to the acre. Nitrogen is applied in two split doses—once in pre-blossom and again in post-monsoon. 30 lb. of phosphoric acid and 40 lb. of potash are applied during post-monsoon season with the second dose of nitrogen. Half the number of plots are given light handling during pre-blossom period.

The yield record of this experiment is furnished in Appendix VII.

Differences in yield are significant this year. Treatment B (N-P-K: 80-30-40) has produced the highest yield. However, in the earlier three years, Treatment A (N-P-K:40-30-40) had produced higher yields.

The experiment is continued.

IV. Robusta Manurial and Pruning experiments (Private estates)

Experiments were laid out in private estates on the same lines as indicated above. These experiments were extended to study the influence of light pruning on yield of coffee with or without application of a complete mixture of two levels of nitrogen and fixed levels of phosphate and potash.

Two levels of nitrogen of 40 lb. and 80 lb are applied in two split doses during pre-blossom and post-monsoon season. The constant levels of P and K of 30 lb. and 40 lb. respectively are applied during the post-monsoon season. In treatments to be pruned, pruning is given pre-blossom.

(a) *Experiment at Bhadra estate, Balehonnur (Mysore State)*

The yield data of this experiment is given in Appendix VIII. The treatments have not been significant. However, the application of manures at 40N, 30P and 40K produced higher yields in two out of three years and in one year the same treatment combined with light pruning proved better.

(b) *Experiment at Devadhanam Estate Balehonnur (Mysore State)*

The yield data of this experiment is given in Appendix IX. Differences in treatments have not been significant; but treatment E (N-P-K: 40-30-40 combined with light pruning) has given numerically higher yield.

Indications from these are that robusta coffee appears to benefit from an application of a lower level of nitrogen at 40 lb. with reference to 30 lb. P and 40 lb. K and responds favourably to a light pruning (handling).

The experiments are continued.

V. Experiment on the influence of topping on growth of robusta coffee (Byregudda Estate, Balehonnur)

This experiment laid out at Byregudda estate, Balehonnur, in 1951, was continued. Growth measurements were recorded at periods of minimum and maximum growth. The first yield in this experiment was harvested this year.

Growth measurements and yield data are furnished in Appendix X.

The results this year are significant. The plants topped at 3 ft. height had put in more growth than those topped at 4 ft. during the first three years. However, during this year plants topped at 4 ft. have made better growth and yielded a higher crop.

VI. Observational studies on Blossom-berry correlations

To study the fruitfulness of some of the important Station Selections, the observations commenced in April 1955 were completed in October 1955.

The data is given in Appendix XI (a). On an average only 41 per cent of the total blossom was retained to the ripening stage.

A similar observation has been started this year also and the observations so far recorded are given in Appendix XI (b).

VII. Studies in the germination of arabica coffee seeds: Coffee Research Station, Balehonnur

An experiment similar to the one carried out in 1954-55 to study the viability of germination of arabica seeds was repeated during the year using seeds of S.333. The data are given in Appendices XII (a) and (b).

The results are concurrent with the earlier observations. It was observed generally that seeds sown with their parchment cover split germinated earlier than the seeds sown with covers intact. None of these were responsible for the final germination rate.

VIII. Brazilian system of planting

One acre of newly opened area at the Coffee Research Station, Balehonnur, is planted according to the Brazilian method, but retaining shade.

Pits of the same dimension as under Indian conditions are opened at a spacing of 13′×8′. Four seedlings of S.795 will be planted in the pit and they will thereafter constitute a 'plant'. About 100 pits will be only half-filled and planting done, as this is expected to protect the young seedlings from wind and sun. All cultural operations will be the same as for arabica. The plot will be heavily mulched and green manure grown between rows.

IX. Experiments at the Coffee Research Sub-station, Chethalli (Coorg)

1. Cultivation Experiment

This experiment started in 1953 was continued. Yield records are given in Appendix XIII.

There appears to be no difference between treatments.

2. Robusta pruning trials

The series of experiments started in 1952 at (1) Yemmigundi, (2) Pollibetta and (3) Cannoncadoo estates in Coorg, for the study of the effects of pruning on robusta were continued.

Yields were recorded and studied; there was no statistical difference among treatments.

3. Studies in the shade requirement of arabica coffee

An experiment to find out suitable types and combinations of shade trees for optimum growth of arabica coffee was laid out in 1955-56 in a newly cleared area.

Locality: Coffee Research sub-station, Chethalli (Coorg).

Treatments: Ten—constituted by grouping nine out of the following ten shade trees for each treatment omitting one at a time

1. *Ficus glomerata* (Atti)
2. *Ficus nervosa* (Malaigargathi)
3. *Dalbergia latifolia* (Beete)
4. *Pterocarpus marsupium* (Honne)
5. *Eugenia jambolana* (Nerale)
6. *Artocarpus heterophyllus* (Jack)
7. *Ficus* sp. (Elibasari)
8. *Albizzia lebbeck* (Kalbage)
9. *Bischofia javanica* (Neeli)
10. *Ficus retusa* (Mitli)

The ten treatments are:

A. Neeli omitted.
B. Jack omitted.
C. Malaigargathi omitted.
D. Mitli omitted.
E. Kalbage omitted.
F. Beete omitted.
G. Nerale omitted.
H. Honne omitted.
I. Elibsari omitted.
J. Atti omitted.

Replications: 6.

Layout: Randomized.

Plot size: $12 \times 12 = 144$ plants in a sub-plot with one shade tree in the centre of a group of $4 \times 4 = 16$ coffee plants.

Plant material: S.795 arabica.

Planting distance: $6\frac{1}{2}' \times 6\frac{1}{2}'$ for coffee.
$26' \times 26'$ for shade trees.

Observations to be recorded:

1. Growth and development of coffee plants.
2. Yield.
3. Disease and pest incidence.

Temporary shade has been provided all over the area uniformly by planting the same number of dadap stakes in each plot. All the plots are manured uniformly.

H. Hanumantha Rao
Agronomy Assistant

II. BOTANY

Work on coffee breeding with reference to leaf disease resistance and high-yielding qualities was continued. Production of seeds from Station selections and cross-breds for finding out the behaviour of the progeny regarding resistance to leaf disease and yield; collection of plant material for establishing at the Station—both local and foreign, vegetative propagation of good bearers, comparative trials of clonal plants from good bearers, morphological and cytological studies of species, varieties and selections of coffee, and supply of seeds and seedlings of approved Station selections to growers formed the principal work of the Division.

Coffee seeds were obtained during the year by courtesy of (1) Coffee Specialist F.A.O., Adis Ababa, Ethiopia, (2) Head, Institute for Agricultural Research, Bogor, Indonesia, (3) Antoine Delfonte Esqr., Compagnie Hauts Plateaux, Indochinois, Saigon, (4) Ernst P. Imle Esq., Tropical Crops Plant Introduction Section U.S. Department of Agriculture and (5) the Senior Research Officer, Coffee Research and Experimental Station, Ruiru, Kenya.

A. COFFEE BREEDING

I. Arabica

1. Cross breeding and selection

Cross breeding arabica coffee with a view to combine desirable characters of selected parents as well as selfing of selected plants for raising the further progeny were continued. 8 crosses were effected between cultures of B.A. series and one between F_3 of S.288 X Kents arabica and a selected plant from an arabica collection from Anglo-Egyptian Sudan established at the station. 3 plants in the III generation progeny of S.26, 2 plants in the F_3

of S.288 X maragogype and one plant among the arabica collection from Anglo Egyptian Sudan were selfed for raising the further progeny. The selfed plants were selected for their vigorous growth and field resistance to leaf disease. Details are given in Appendix XIV.

2. Field studies of advanced generations and hybrids

Field studies on leaf disease resistance and high yielding characteristics of selections were continued.

(a) 1952 Series

The block planted in 1952 with progeny of S.795 and S.333, F2 of S.26 X Kents arabica and 5 intra crosses with arabica cultures continued to be under observation. It was observed that 2.4 per cent plants of S.795, 2.0 per cent plants of S.333 progeny and 5.6 per cent plants in F_2 of S.26 X Kents arabica were susceptible to leaf disease in the field. A first crop of 1 cwt. of clean coffee per acre was recorded on S.795 progeny and $\frac{1}{2}$ cwt. on S.333 during 1955-56 season.

(b) 1953 Series

The plants from 11 Station selections and 3 hybrids from a neighbouring estate planted in 1953 are developing the first crop. All the plants appear to be so far free from leaf disease in the field except upto 10 per cent in each of four crosses—S.31 X S.22, S.645.1/4 X S.583.1/9, S.580.2/13 X S.26 and S. 580.2/13 X S.645.1/4.

(c) 1954 Series

Progeny of 11 intra-crosses between arabica cultures planted during September 1954 did not show leaf disease this year though during 1954-55 two of these showed leaf disease upto 2.7 per cent and 1.6 per cent.

(d) 1955 Series

9 intra-crosses between arabica cultures and one F_2 generation of an arabica selection cross-bred with Kents arabica were planted in contiguous plots in an area of 50 cents during September 1955. So far leaf disease is seen upto 1.3 per cent in the field in 4 intra crosses.

3. Comparative trials of clonal progeny from best performers:

B.A. Series I. The trial to test the comparative merits of 20 arabica cultures (B.A. 5, 6, 11, 12, 13, 19 to 27, 30 to 32 and 34 to 36) planted in 1951 and 1952 was continued. The plants are so far free from leaf disease in the field. The second crop from the replications planted during 1951 was recorded. The first crop on the replications planted during 1952 was negligible. The average yield of the cultures in terms of clean coffee per acre is given in Appendix XV.

B.A. Series II. The trial to test the comparative merits of 16 arabica cultures (Clonal progeny of B.A. 1, 4, 7 to 10, 13 to 18, 28, 29 and 33 and seedling progeny of B.A. 19) planted in 1952 and 1953 was continued. All the plants are so far free from leaf disease in the field. The first crop on the replications planted during 1952 was negligible.

Note: Particulars about these 36 cultures of the B.A. series have been published in the earlier Annual Reports.

4. Observational studies on the performance of the progeny of outstanding plants selected from private estates

(a) *Estate Collections*—1952 *Series:* The block planted with Kurkenmutty, Lalbagh and Moganad peak estate collections continued to be under observation. The plants continued to have vigorous growth. 5 to 11 per cent of the plants in the progeny of the Kurkenmutty estate (Mysore State) collections, upto 42 per cent of the plants in the progeny of Lalbagh estate (Mysore State) collections and 4 per cent of the plants in the progeny of Moganad peak estate (Shevaroys, Madras State) collections showed leaf disease in the field. The first crop on these plants will be harvested during 1956-57.

(b) *Estate Collections*—1954 *Series:* The block planted with Vasambady, Glenpeak and Moganad Peak estates (Shevaroys, Madras State) collections continued to be under observation. During the year, 1.3 per cent of the plants in Vasambadi collections and 5.9 per cent of the plants in Moganad peak collections showed leaf disease in the field.

(c) *Estate Collections*—1955 *Series:* 128 plants raised from seeds collected from two outstanding plants, one each in Scotforth estate (Shevaroys, Madras State) and Adarwally estate (Mysore State) were planted during June 1955. So far these plants are free from leaf disease in the field.

(d) *Estate Collections*—1956 *Series:* 90 plants raised from seeds of an outstanding plant at Woger estate (Mysore State) and 48 plants from a hybrid plant at Kogilahalla estate (Coorg) were planted at the Station during June 1956.

(e) Collection of seed material from outstanding plants in private estates was continued. Seedlings have been raised from seeds of two plants from Kotada estate (Nilgiris, Madras State). One of the plants has green coloured young leaves and golden yellow fruit-skin; the second plant has bronze coloured young leaves and red fruit-skin. These plants are reported to be vigorous, resistant to leaf disease in the field and bearing even annual crops.

5. Inter-specific crosses

(a) *Arabica-Robusta crosses*

The 2nd back-cross progeny of S.274 Robusta X Kents arabica with Kents arabica, planted during 1954 continued to show vigorous growth and field resistance to leaf disease.

(b) *Devamachy Hybrid collections*

Early in 1953, 10 crosses were effected between arabica selections of the Station and the Devamachy hybrid collections described in earlier reports. 279 seedlings from these crosses have been planted in contiguous plots during 1954-55. Apart from two crosses which showed susceptibility to leaf disease upto 2 per cent in the field, the rest continue to be free from disease and are vigorous in growth.

7 more crosses were effected between arabica selections of the Station and these Devamachy hybrids during March—April 1956.

II. Robusta

1. Comparative trials of clonal progeny from best performers

B.R. Series I: Clonal progeny trials with ten robusta cultures B.R. 2, 3, 5, 6, 7, 9, 11, 12, 15 and 17 planted in 1951 and 1952 were continued. A first crop was taken during the year under report and the average yield of the cultures in terms of clean coffee per acre is given in Appendix XVI.

B.R. Series II: Clonal progeny trial with 9 robusta cultures (clones of B.R. 1, 4, 6, 8, 10, 13, 14, 16 and 17 and seedling of S.274) planted during 1952 and 1953 was continued. A negligible first crop was noticed in the 1952 plantings and was removed at the flower stage.

2. Collection of seeds from outstanding plants of robusta selected in private estates

Seedlings from seeds of 40 marked plants from Hope Estate in Coorg State, were raised during 1954, and 1136 plants of these were planted during June 1956 at the Station in contiguous plots on terraces for a study of their performance.

III. Collection of coffee seed material from countries outside India

Collection of seeds of coffee species, varieties and selections from countries outside India was continued.

(a) World collections—1953 Series

The five varieties of arabica—Bourbon amarelo, Bourbon vermelho, Catura amarelo, Laurina maragogype and Mundo Novo—planted during September 1953 along with Stations Selections—progeny of B.A. 1, B.A. 12, B.A. 16 and B.A. 19—continued to be under observation. It is noticed that under the conditions at the Station, all the 5 varieties and upto 10 per cent of the plants of the Station selections show susceptibility to leaf disease in the field. A small crop is developing on the plants.

(b) World collections—1954 Series

The 27 varieties of arabica, 7 arabica selections of Coffee Research Station, Lyamungu, Kawisari-D and Station selections S. 288 and S. 446 planted during Jan-Sep. 1954, continued to be under observation. The plants were protected with bordeaux mixture spray as most of the collections showed susceptibility to leaf disease. Comparatively S.288 was free from the disease.

(c) World collections—1955 Series

Further to the 31 varieties of arabica and *Coffea stenophylla*, *Kawisari-B & D*, *C. canephora*, *C. dewverei excelsa* and *C. dewverei* planted in June 1955 along with Station selections, 71 seedlings of *Coffea racemosa* and *C. lygustroides* and 448 seedlings of 11 varieties of *C. arabica* were planted during September 1955. Upto 14 per cent leaf disease susceptible plants have been noticed in *C. arabica* varieties Dilla Melville, Dilla (mixed), Gimma M'buni, Gimmma Galla Sidamo, Costa Rica, Columbie, Macenta, Salvador, Kouti, Kenya, M Kougoun, Nicaragua, Mazeron, S.17 Yrgalem and Station Selections S. 645 and S.327.

(d) World collections—1956 Series

229 seedlings raised from seeds of 5 species of Coffee and 650 seedlings raised from seeds of 16 varieties of C. arabica obtained from countries outside India during 1955 have been planted at the Balehonnur Station during June 1956.

(e) The following seed material was received during the year under report from Institutions abroad and seedlings have been raised from these:

Material received	*Source*
Coffea arabica	
1. Harar Arba Gugu Arussi.	Coffee Specialist, Food and Agricultural Organization of the United Nations, P.B. No. 1039, Adis Ababa, Ethiopia.
2. Harar Dugda Lemita Arussi.	
3. Harar Baca Harar.	
4. Mokka Dilla Sidamo.	
5. Badabuna Gimma Kaffa.	
6. Babaca Kaffa.	
7. Misan Taffari Kaffa.	
8. Eniambu Kaffa.	
9. Limmu Gimma Kaffa.	
10. Amphillo.	Senior Research Officer, Coffee Research and Experimental Station, Dept. of Agriculture, Ruiru, Kenya.
11. Kents.	
12. Padang.	Ernst P. Imle, Esq., Tropical Crops Plant Introduction Section, United States Dept. of Agriculture, Horticultural Crops Research Branch, Beltsville, Maryland, U.S.A.
13. Philippenian.	
14. Polysperma.	
15. Villalobus.	
16. Pache.	
17. Bourbon amarelo.	
18. Catura amarelo.	
19. Bourbon vermelho.	
20. Catura vermelho.	
21. Mundo Novo.	
22. Amphilla.	
23. Geisha.	
24. Sudan Rume.	
25. Angustifolia.	
26. Anomala.	
27. Anormalis.	
28. Cera.	
29. Erecta.	
30. Goiba.	
31. Laurina.	
32. Maragogype amarelo.	
33. Maragogype vermelho.	
34. Moka.	
35. Purpurescence.	
36. Semperflorence.	
37. Typica.	
38. Xanthocarpa.	
39. Murta.	
40. Arabica H.I.	
41. K.P. 532.	
42. A.C. 53.	
43. A.C. 98.	
44. N. 39.	
45. F. 502.	
46. S. 16 (PR)	
47. S.A. 158.	
48. Cumbaya normal.	
49. Cumbaya abnormal.	
Coffea robusta	
50. L. 36.	
51. L. 48.	
52. L. 93.	
53. L. 147.	
54. L. 215.	
55. L. 251.	
56. Robusta.	Antoine Delfonte Esq., Campagnie, Hauts Plateaux Indochinois, Bureaux A Saigon,

(f) Collection of coffee material received from foreign institutions since 1953 consists of 110 varieties, forms and selections of arabica coffee, 4 varieties of liberica, 10 varieties and selections of robusta, two varieties of excelsa, Kawisari-B & D, congensis, stenophylla, eugenoides, racemosa, salvatrix, Kapakata and ligustroides. A list of species, forms and selections so far collected is given in Appendix XVII.

B. EXTENSION WORK WITH SELECTIONS

1. Seed blocks

(a) The seed block established with S.795, S.947, S.532, S.645 and S.846 during September 1954 was maintained. The plants, particularly S.795, are showing vigorous and healthy growth.

(b) A block of 4½ acres was planted to S.795 arabica in hedge rows on terraces during September 1955 with a view to develop it as a seed block at the Station.

(c) To meet the increasing demand for seed coffee of Station selections, the scheme of establishing zonal seed plots of Station selections on private estates initiated during 1954-55 was continued. The following estates very kindly co-operated with the Department in continuing the seed plots established on their estates.

Mysore State

1. Urvinkhan estate, Javali P.O.
2. Mandalkhan estate, Santaveri P.O.
3. Bagneheddal Estate, Chikmagalur P.O.
4. Tippanahalli estate, Chikmagalur P.O.
5. Yellikodige Estate, Aldur P.O.
6. Bettadamane estate, Mudigere P.O.
7. Archullie estate, Mudigere P.O.
8. Daithapura estate, Ballupet P.O.
9. Barguai estate, Saklaspur P.O.
10. Hiregurje estate, Arehalli P.O.
11. Badra estate, Balehonnur P.O.
12. Devadhanam estate, Balehonnur P.O.

Coorg

13. Balagunda estate, Somwarpet P.O.
14. Kibetta estate, Somwarpet P.O.
15. Haradoor estate, Sunticoppa P.O.
16. Madapur 'A' estate, Madapur P.O.
17. Pannia estate, Sunticoppa P.O.
18. Coovercolly group estates, Somwarpet P.O.

Shevaroys (Madras State)

19. Moganad peak estate, Yercaud P.O.
20. Cauvery peak estate, Yercaud P.O.
21. Vasambadi estate, Yercaud P.O.

Nilgiri-Wynaad (Madras State)

22. Glenvans estate, Ouchterlony valley estates (1938) Ltd., New Hope P.O.

Off type plants in these plots were rouged out and seed coffee was prepared under the supervision of the Department.

2. Seed distribution

(a) During the year 3,609 lb. seed of arabica selections, 923 lb. seed of robusta selections and 27 lb. seed of excelsa were supplied to growers from seed prepared at the two Research Stations.

(b) 3 lb. 13 oz. seed of arabica selections and 1 lb. 2½ oz. of robusta selections were supplied to (1) Senior Research Officer, Coffee Research and Experimental Station, Ruiru, Kenya, (2) Head, Plant Introduction Section, U.S. Department of Agriculture, Horticultural Crops Research Branch, Beltsville, Maryland, U.S.A., (3) Head, Forest Research Laboratory, Agricultural Research Station, Rehovot, Israel, and, (4) Director, Experimental Station, C.P.V., Proefstation Der Centrale Proefstations Vereniging, Bogor, Indonesia.

(c) 7,060 lb. seeds of arabica selections and 430 lb. of robusta were supplied to growers from seedblocks in private estates.

(d) During the year under report, 1693 planters were supplied with 10,669 lb. seed of arabica selections, 1,353 lb. seed of robusta and 27 lb. seed of excelsa from the two Research stations and the zonal seed blocks. This quantity of seed material is considered sufficient for planting an area of 10,669 acres of arabica selections and 2,706 acres with robusta at the rate of 1 lb./acre in the case of arabica and ½ lb./acre in the case of robusta. Appendix XVIII shows the progressive increase in the supply of seed coffee of Station Selections from the year 1949.

3. Performance of Station Selections

The yield performance of S.288 and S.795 as ascertained from some of the private estates is given in Appendix XIX.

4. Regional seedling nurseries

The scheme of establishing regional nurseries in private estates in all the liaison zones for supplying seedlings from these to planters in the immediate neighbourhood was revived. 1,44,000 seedlings of arabica selections and 29,000 seedlings of robusta selections are expected to become available for distribution to growers from 26 nurseries established at the two Research Stations and 7 Liaison zones.

C. VEGETATIVE PROPAGATION

1. Grafting

(a) **Top working:** Trials to find out an easy technique for top-working robusta coffee plants with scion wood from high yielding leaf disease resistant arabica selections were continued. 95 per cent of the 535 grafts done in May-June 1955 with S.288 scions on robusta suckers registered a successful 'take'. There was no difference in the percentage 'take' at the two levels of grafting. A few grafts done at 2 to 2¼ ft. height from ground level were observed to break at the graft joint in high winds during July—August 1955. No such damage was noticed on the grafts done at 6 to 9 inches height from ground level. The grafts are making satisfactory growth.

(b) **Conversion of young robusta plants in the field to arabica by grafting**

The grafts done on 43 three-year-old robusta plants during May—June 1955 continued to make satisfactory growth. During 1955-56, there was a sparse crop on the branches of robusta stock. It is proposed to remove the robusta branches as the scion develops and forms a good crown.

(c) **Grafting on suckers raised on stumped robusta plants**

413 robusta plants inter-mixed in arabica plots were stumped during May 1955 and three suckers per plant were raised. At the same time, two suckers

per plant were allowed to grow on high yielding vigorous and leaf disease resistant arabica plants (S.288 II generation) for scion wood. During June 1956, one sucker on each robusta plant was grafted at a height of 6 to 9 inches from ground level. Suckers from S.288 II generation were used as scion. Wedge-grafting technique was adopted. 10.2 per cent of the grafts have been failures.

(d) **Conversion of mature robusta plants in the field by grafting**

With the aim of converting grown up robusta plants to arabica without stumping, a small-scale trial on grafting tender suckers of 2 to 3 months' growth on robusta plants, was undertaken during June 1955. One sucker on each of 50 robusta plants was wedge-grafted with sucker scions of S.288 (III Generation) of similar age and size. 90 per cent 'take' was recorded.

Tender suckers of 2 to 3 months' growth on 309 robusta plants at the Coffee Research Station, Balehonnur, were wedge-grafted with sucker scion of S.288 (III generation) of similar age and size during June 1956. One sucker on each robusta plant was grafted. 83 per cent 'take' was recorded.

Tender suckers of 2 to 3 months' growth on 378 robusta plants at the Coffee Research sub-station, Chethalli, were wedge-grafted with sucker scion of S.288 and S.795 of similar age and size during June 1956. One sucker on each robusta plant was wedge-grafted. 84 per cent 'take' was recorded. (Figure 1 & 2)

Periodical centring on the grafted robusta plants was done at both the Stations to allow sufficient air and light to the grafted suckers.

(e) **Grafting demonstration**

A grafting demonstration was held from 25th to 30th May 1956, at the Coffee Research Station, Balehonnur. 12 planters attended the demonstration. At the Coffee Research Sub-station, Chethalli, a grafting demonstration was held from 3rd to 10th June 1956. 27 planters and their field staff attended the demonstration.

2. **Rooting of sucker cuttings**

1,250 rooted cuttings from (a) 36 arabica selections of the B.A. series, (b) 15 robusta selections of the B.R. series, and, (c) S.26, S.31, S.795, S.645 and Kents arabica were produced during the year. They were utilized for planting in experimental plots.

D. MULTIPLE STEM VS. SINGLE STEM SYSTEM OF GROWING COFFEE

Training coffee on Multiple stem system is a common practice in Central American and East African coffee areas. The main advantages appear to be regular and controlled cropping and simplicity of pruning. With a view to gain local experience and knowledge, experiments were laid out at the two Stations since 1950, to compare the single stem and multiple stem systems of growing coffee.

1. **Arabica**

Experiment I. This experiment started in May 1950, as described in earlier reports was continued. The fifth crop after conversion was recorded. The data are given in Appendix XX.

On the aggregate of five years' yield completing the first cycle, the multiple stem plots have recorded 0.3 per cent increase over the single stem plots. Thus there does not appear to be any appreciable increase in yield from the multiple stem system of growing coffee.

Experiment II. This experiment started in 1951 as per details furnished in the earlier reports, was continued. The fourth yield after conversion was recorded. The treatments are:

A. Single stem.

B. Primary branches on one side were pruned off during March 1951 to encourage free growth of suckers for forming the multiple stems. After crop harvest during March 1952, the main stem was stumped to a height of 2 ft. from the ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

C. Extended centring upto one foot from the centre was done during the year of conversion (1951) to facilitate free growth of 3 suckers for forming the multiple stems. After the crop harvest during March 1952, the main stem was stumped to a height of 2 ft. from the ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

D. Except the two top primary branches all the other branches were cut down during the year of conversion (1951) to facilitate free growth of three suckers. After crop harvest during March 1952, the top-most primary branch was retained to act as a lung branch and the three suckers form the multiple stems.

The fourth yield after conversion was recorded. Data are given in Appendix XXI.

The growth of suckers for forming the multiple stems is observed to be the best in Treatment B.

After crop harvest during February—March 1956, the lowest pairs of primary branches were pruned off on the multiple stems. No plant in single stem or multiple stem plots was damaged during shade lopping or from stem borer infestation. Taking the aggregate of four years' yield after conversion, Treatments B, C and D have recorded 2.55 per cent, 21.12 per cent and 10.24 per cent increased yield respectively over Treatment A (Single stem).

Experiment III. This experiment started in 1951, as described in earlier reports, was continued. The fourth yield after conversion was recorded. Data are furnished in Appendix XXII.

After crop harvest during February-March 1956, the lowest pairs of primaries were pruned off on the multiple stems. No plant was damaged either on single or on multiple stem plots during shade regulation or from stem borer. Taking the aggregate yields of four years after conversion, the single stem plots have registered 26.35 per cent increased yield over the multiple stem plots.

2. Robusta

The experiment on robusta started in 1951 as per details furnished in earlier reports was continued. The fourth crop after conversion was recorded. The yield data are given in Appendix XXIII.

On the aggregate of four years' yield, the single stem plots have recorded 44 per cent increase over the multiple stem plots. Shot hole borer infestation on the multiple stem plants continued to be heavy as in the earlier years and a number of branches had to be removed and destroyed.

FIG. 1

Robusta plant top worked with arabica scion

FIG. 2

Tender sucker on robusta plant is grafted with arabica scion of similar stage of development

E. LABORATORY STUDIES

Cytological studies were continued with a view to gain knowledge on the chromosomal make-up of species, varieties and selections of *Coffea* to help in the coffee breeding programme. As a first step, the chromosome morphology and microsporogenesis in *Coffea robusta* (*C. canephora*) were studied in detail.

1. Studies on chromosome morphology

Coffea arabica has 2n=44 chromosomes and *Coffea robusta* 2n=22 chromosomes. The 22 somatic chromosomes of *C. robusta* are observed to consist of the following:

One pair of long chromosomes, 3.2 micra long, with a centric primary constriction and a secondary sub-median constriction.

One pair of long chromosomes slightly smaller than the above with a sub-median constriction.

Two pairs of medium sized chromosomes varying in length from 1.5 to 2 micra, with a sub-median constriction.

Seven pairs of short chromosomes, about 1 micron long, with median or sub-median constriction.

2. Studies on Microsporogenesis

Microsporogenesis in *C. robusta* (S.274) was observed to be regular. 22 chromosomes paired regularly and formed 11 bivalents at the metaphase. Subsequent behaviour of the chromosomes during anaphase and second division was also found to be regular in a majority of the pollen mother cells. In about 4 per cent of the pollen mother cells, abnormalities such as failure of pairing and lagging of chromosomes were noticed. 4 to 8 per cent of the pollen grains were found to be shrivelled and shrunken and had very little starch grains.

3. Colchicine treatment of robusta seedlings to induce doubling of chromosomes

Attempts were made to induce doubling of chromosomes in *C. robusta* with a view to obtain tetraploids and use them in crossing with arabica. Seeds, just sprouting seedlings and seedlings at cotyledonary stage were made use of for the purpose and different strengths of colchicine solution were used for varying durations of time. Just sprouting seedlings and seedlings at cotyledonary stage were found to be favourable and treatment with 0.3 per cent colchicine solution for a duration of 48 to 72 hours was found to bring about doubling of chromosomes in a majority of cells. So far doubling of chromosomes has been successfully induced in two seedlings of robusta. They have developed 5 pairs of leaves and all the leaves are bigger, thicker, and crinkled in appearance.

F. MISCELLANEOUS CROPS

1. Green manure

Specimen plots of the following green manure plants were continued:

Crotalaria anagyroides.	*Desmodium ovalifolium.*
,, *usaramoensis*	*Calapogonium mucunoides.*
,, *Grahamiana.*	*Centrocema pubescens.*
,, *Brownii.*	*Stylosanthes gracilis.*
Tephrosia candida	*Mimosa invisa.*
,, *vogelii.*	*Pueraria javanica.*

8 lb. of green manure and cover crop seeds were supplied to indentors during the year.

2. Shade trees

Maesopsis eminii have grown to good-sized trees. 6 lb. of seeds were supplied to the Conservator of Forests, Shimoga, Mysore State.

Experiments at the Coffee Research sub-station, Chethalli

1. Varietal trial—1949

The varietal trial laid out in 1949 to test Selections S.795, S.288, S.645 and S.446, as described in the earlier reports, was continued.

Leaf disease susceptible plants were rogued out from S.795, S.288 and S.645, numbering 5, 9 and 1 respectively. Since S.446 is susceptible to leaf disease, rogueing out was not done.

The fifth crop from these plots was harvested. Data are given in Appendix XXIV.

2. Grafting

Young robusta plants were grafted with scions from S.795 and S.288 arabica during May-June 1956 as mentioned in para C. 1 (d) above.

R. L. NARASIMHASWAMY
Botanist

III. CHEMISTRY

Experiments on the manurial requirements of coffee, land management with special reference to soil and moisture conservation, influence of trace elements on growth and health factors and studies on the processing of coffee formed the main items of work of this division. The division also attended to routine examination of soils and manures for advisory work and undertook visits to problem areas for investigation and advice on soil and crop husbandry.

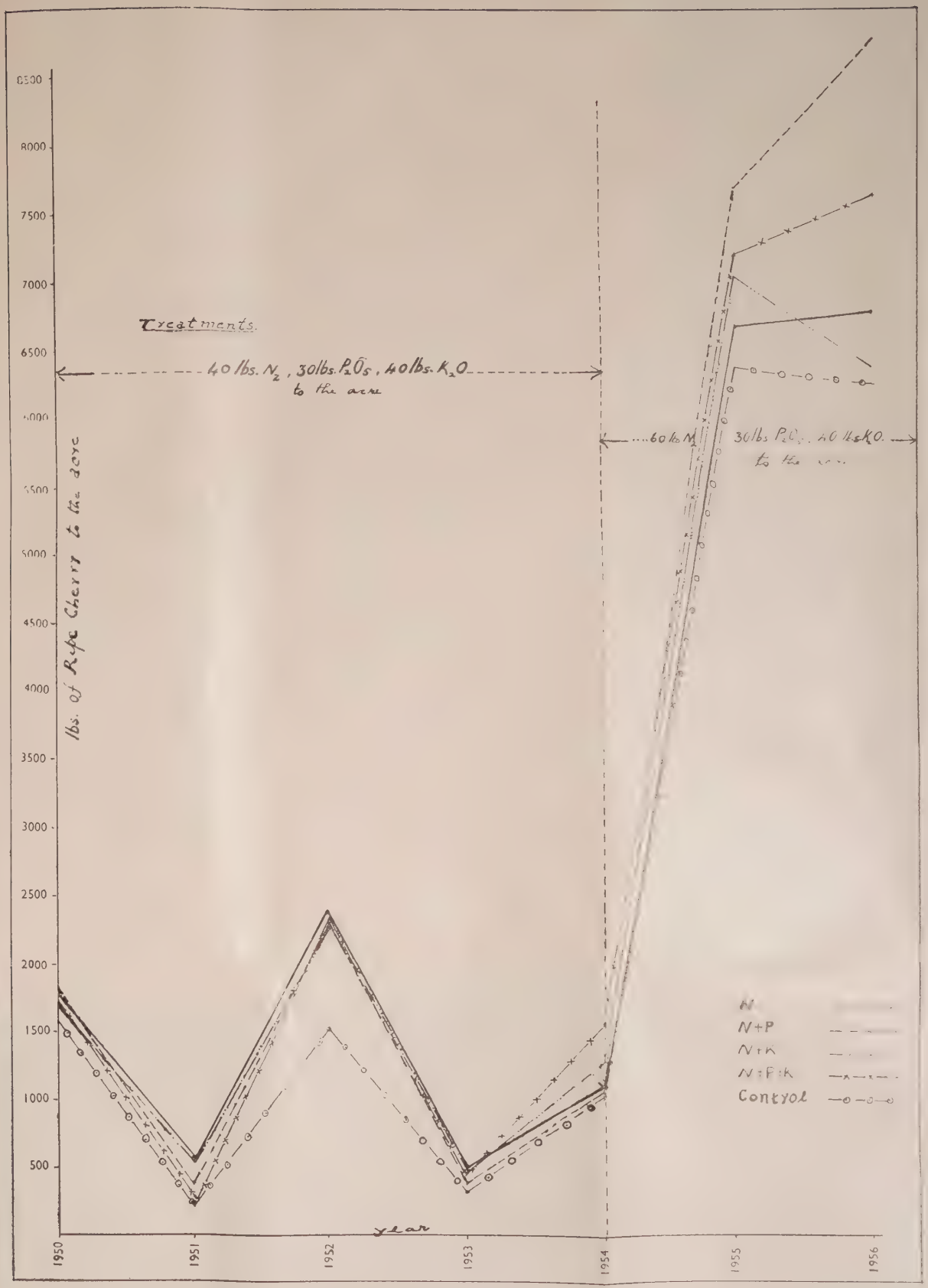
Field Experiments

A. Manurial Experiments

(i) Studies on the essential requirements of plant foods N.P.K. for coffee in relation to improvement in yield (New Manurial Series)

This experiment described in detail in the previous reports was continued. In the post-monsoon of 1955, leaf disease caused heavy shedding of older leaves. This was followed by die-back. The dead branches were pruned off in January. It was observed, however, that the recovery of foliage was much quicker in the manured plots as compared with the control plots. The yield record of the experiment and the percentage of floats in the harvest are given in Appendix XXV. As reported earlier, the plant population in the experimental area was halved. Yields have been calculated on the crop produced by twenty plants which exist now in the sub plots and also calculated for 40 plants for purposes of comparison. (Graph 1)

The trend of increase in yield noted last year has been kept up. An examination of the data shows that treatment B (N+P) is significantly superior to A (N only), C (N+K) and E (Control), but not to D (N+P+K) in both ripe cherry and clean coffee yields. In the analysis of the average yield of ripe cherry over 16 years, treatment B (N+P) has been significantly superior to treatments A (N only) and E (Control) but not to D (N+P+K) and C (N+K). Treatments D and C are significantly superior to E but not to A. In the analysis of the average yield of clean coffee over 8 years, treatment B is significantly superior to treatments A, C and E but not to D. Treatment D is


New Manurial Series No1 - Yield Data
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
lbs. of Ripe Cherry to the acre
Treatments.
40 lbs. N2, 30 lbs. P2O5, 40 lbs. K2O to the acre
60 lbs N, 30 lbs P2O5, 40 lbs K2O to the acre
N
N+P
N+K
N+P+K
Control
year
1950
1951
1952
1953
1954
1955
1956

significantly superior to E but not to A and C. Treatments A and C are not significantly superior to E.

In the determination of floats by weight and volume, unlike as in the previous years, the treatments have not been significant. Treatment B (N+P) continues to have the highest percentage of floats. As compared with previous years, the floats percentage has been very low during the year under report.

Grouping the yield of clean coffee in cwt/acre into periods of five years and calculating the yield as percentage of control, the following results are obtained:

	N	N+P	N+K	N+P+K	Control
1949-53	136.3	129.0	129.0	126.6	100
1950-54	141.8	129.1	138.0	136.7	100
1951-55	120.1	129.8	122.0	122.7	100
1952-56	112.6	130.0	112.8	120.4	100

The following trends become evident from the above table:

(1) Yield increase over control has been steady in the case of treatment N+P.

(2) Yield increase over control has been decreasing in the case of the other treatments—N, N+K and N+P+K; with N+P+K the decrease is less than N or N+K.

(3) Phosphates help in the better utilization of Nitrogen and therefore with increases in the application of nitrogen it would be necessary to supply adequate amounts of phosphates.

(4) Potash does not appear to produce similar effect with increased nitrogen.

(ii) Studies on the manurial requirement of coffee in relation to improvement in yield

(a) N.P.K. trials with varying levels of N.P.& K (Fundamental Manurial Experiments in the pH cisterns)

This experiment laid out in 1950 was continued. Treatment F (45N-67.5P-90K) is significantly superior to treatment B (30N-30P-30K) and not to others in the analysis of yield of ripe cherry, and narrowly misses significance in clean coffee. In the analysis of the average yield of ripe cherry and clean coffee over three years, the treatments have not been significant—vide Appendix XXVI. The significance is only with 't' test and not with the 'f' test and therefore may be considered only as trend.

In the determination of floats by weight and volume, the treatments have not been significant.

(b) N.P.K. trials with varying levels of nitrogen with constant levels of P.& K. (17-acre Manurial experiments 1952-series)

This experiment started in 1952 was continued. The plants were allowed to crop fully unlike as in the last year when only the blossom on the brown wood was allowed to set whilst that on the green wood was rubbed off. Owing to the indifferent blossom showers received during the year and the extreme drought conditions experienced during the hot weather, set has not been satisfactory. The crop picked during December 1955 averaged as follows:

Calculated clean coffee

A.	Control.	2.07 cwt/acre.
B.	80N-30P-40K.	2.72 ,,
C.	100N-30P-40K.	3.13 ,,
D.	60N-30P-40K.	2.74 ,,
E.	40N-30P-40K.	2.58 ,,

(c) N.P.K. trials with constant levels of N.P.K. but varying sources of nitrogen (17-acre manurial experiments—1953 series)

This experiment started in 1953 was continued. The blossom on the brown wood was allowed to set whilst that on the green wood was rubbed off. The blossom was indifferent and patchy.

(d) N.P.K. Trials with varying levels of P & K and constant level of nitrogen (17-acre manurial experiments—1954 series)

This experiment started in 1954 was continued. The blossom was all rubbed off as the plants are still very young.

(e) Comparative trials on the influence of different forms of nitrogen on the growth and yield of coffee—(Experiments in Rubber area)

This experiment started in 1953 was continued. The yield record is given in Appendix XXVII.

The treatments have not been significant. Treatment B (Calcium cyanamide) has been numerically superior to treatment A (Urea) and treatment C (Ammonium sulphate nitrate). The analysis of average yield of cherry over three years has shown that the treatments are not significant. As in the previous year, treatment A is numerically superior to treatments B and C.

(f) N.P.K. trials with varying levels and combinations—(Arabica manurial experiment at the Coffee Research sub-station, Chethalli, Coorg)

This experiment started in 1952 was continued. The plants were allowed to crop fully unlike as in the last year when only the blossom on the brown wood was allowed to set and that on the green wood was rubbed off. The crop that was picked during 1955 December averaged as follows:

	Treatments			Yield of clean coffee in cwt. acre		Treatments			Yield of clean coffee in cwt. acre
	N.	P.	K.			N.	P.	K.	
1.	0	0	0	1.81	9.	90	0	0	2.65
2.	0	45	0	1.17	10.	90	45	0	1.80
3.	0	0	60	1.04	11.	90	0	60	2.31
4.	0	45	60	1.33	12.	90	45	60	2.60
5.	60	0	0	1.38	13.	120	0	0	2.85
6.	60	45	0	2.21	14.	120	45	0	2.38
7.	60	0	60	2.22	15.	120	0	60	2.25
8.	60	45	60	3.19	16.	120	45	60	2.63

(g) Studies on the effect of aldrinised fertilizers on yield of coffee

It is claimed that Aldrin selectively destroys all the harmful soil insects and thus indirectly helps in increased yields. Two experiments were started, one at the main Station at Balehonnur and the other at the Sub-station at Chethalli.

Details of the experiments are given below:

Area of Experimental plot: 60 cents. *Size of sub-plot:* 6×5=30 plants.
Layout: Randomised block design. *Planting:* 6′×6′.
Replications: 6. *Guard row:* A general guard row around the exptl. plot.
Treatments: 4.

A. 440 lb. of fertilizer mixture to the acre per year to give 80 lb. of N_2, 45 lb. P_2O_5 and 60 lb. K_2O to be applied in three equal doses during:
   1. Preblossom.
   2. Post blossom premonsoon.
   3. Post monsoon.

B. Same as in A above+2.25 lb. of Aldrin.
C. Same as in A above+1.5 lb. of Aldrin.
D. Same as in A above+1 lb. of Aldrin.

The sub-plots are separated by drains 9″ deep.

Yield Records: Pick from each sub-plot is being maintained.

This year's yield forms basic data.

Observations: Observations regarding the control of soil insects by the toxicant are being made by the Entomologist.

The fertilizer mixtures were supplied by Messrs. Shaw Wallace and Co. Madras.

(h) 1. Test scale observational trials on the effect of increasing doses of manures on coffee

Two test-scale observational trials, one on Robusta and the other on arabica, to study the effect of increasing doses of manures were laid out at the Coffee Research Station, Balehonnur, during May 1956. Manures are applied at monthly intervals to 12 robusta and 12 arabica plants; 12 other robusta and arabica plants serve as controls. The first treated plant receives a single application of 40-30-40 N-P-K mixture in a year; the second, two applications (80-60-80) and so on until the 12th plant receives 12 applications (480-360-480 of the mixture in a year.

The results will be watched and any positive indications will be followed up by comprehensive field trials.

2. Field trials to find out the maximum economic dose of nitrogen and the role of phosphates and potash in balancing the nitrogen utilization

This experiment was laid out in May 1956 on mature yielding arabica coffee in the Coffee Research Station, Balehonnur, to study the effect of application of comparatively high doses of nitrogen with and without adequate quantities of phosphates and potash, and also to study the effect of soil amendment with large quantities of rock phosphate. Following are the details:

Treatments: *Main 6*—with six levels of nitrogen from 0 lb. to 800 lb. to the acre annually with and without phosphoric acid and potash.

Nitrogen level lb./acre	*Symbol*	*Phosphoric acid* lb./acre	*Potash* lb./acre
1. 0	D.	0	0
2. 50	A.	30	40
3. 100	F.	45	60
4. 200	C.	90	120
5. 400	E.	180	240
6. 800	B.	360	480

Sub-Treatments: $2 \times 2 = 4$. Each of the main sub-plots is divided first into two equal halves and a basal dressing of 1 lb. of finely ground mineral phosphate per plant to be applied to one half at the commencement.

Each of these two halves is again divided into two and one quarter from the half receiving the basal dressing and another quarter from the half without basal dressing are given phosphoric acid and potash at the specified rates along with the nitrogen.

Plot size: 45 plants in a nett sub-plot with common border in between adjacent sub-plots in strips of 3 rows × 15 plants splitting at the 4th, 8th and 12th plants respectively for the sub-treatments.

Replications: 3. *Layout:* Randomised.

Time and Method of application: The 50 lb. nitrogen level is given in two equated doses in March and October while all the rest are given in four equal doses in March, May, August and October—as a broad band within the drip circle of each plant under the leaf mulch.

Observations: 1. Yield record from each nett sub-plot added up from the quantities from the four quarters in terms of fresh cherry and clean coffee.
2. Study on the influence of the treatments in ripening of the fruits.
3. Observations on growth response and uptake of nutrients by simple field tissue tests.

(iii) Field trials on private estates

(a) Studies on the application of nitrogen only in divided doses in relation to yield of coffee

This experiment laid out in 1953 in one of the private estates (Ossoor Estate, Saklespur, Mysore State) was continued.

The yield records of the experiment are given in Appendix XXVIII. The treatments have not been significant.

(b) Effect of different sources of nitrogen on the growth and yield of mature yielding coffee

A field study on mature coffee situated under uniform mixed shade was started in April 1956 in the Shegode estate near the Coffee Research Station, Balehonnur.

Treatments: 6. Nitrogen at 80 lb. to the acre annually in the form of:

1. Ammonium sulphate.
2. Urea.
3. Calcium ammonium nitrate.
4. Ammonium sulphate nitrate.
5. Chilean nitrate.
6. Untreated (control.)

Replications: 6. *Layout:* Latin square.
Plot size: Gross 10 × 7. *Nett:* 8 × 5.

(iv) Field manurial trials on private estates on arabica

The trials started in 1954 on ten private estates situated in different soil climatic zones of the coffee growing tracts of South India were continued. The following trends become evident from the data:

1. As between the application of Nitrogen alone in two and three doses, increases in yield due to the latter over the former are two out of ten cases at 40 lb. level, 6 out of 10 at 60 lb. and 80 lb. levels, and 7 out of 10 at 100 lb. level. This would indicate that when nitrogen is applied at more than 40 lb. per acre, it would prove profitable to do so in more than two doses.
2. The increase due to the addition of 30 lb. phosphoric acid to the acre along with nitrogen is 9 cases out of 10 with 40 lb. nitrogen, 6 cases out of ten with 60 lb. and 80 lb. nitrogen, and 3 cases out of ten with

100 lb. nitrogen. This would indicate that the 30 lb. of P_2O_5 per acre was adequate upto to 80 lb. nitrogen but was insufficient at 100 lb.

3. Addition of potash does not appear to produce similar effects with increased nitrogen.

It is too early to draw any conclusions and the results will be discussed after studying further yield records.

(v) Manurial Experiments on robusta coffee

(a) N.P.K. trials with varying levels and combinations (Coffee Research sub-station, Chethalli, Coorg)

This experiment started in 1954 was continued.

(b) Field manurial trials on robusta Coffee

The experiments started in 1955 in six private estates in Wynaad (Madras State) and Saklespur (Mysore State) were continued. The first year's yield data from the experimental plots have been recorded.

(c) Modified field trials on robusta coffee

It is well known that robusta is by nature predisposed to vegetative growth and consequently heavy application of nitrogen unaccompanied by proportionate additions of phosphate and potash may not produce greater crops. In order to find out the optimum combination of N.P.K., field trials were started at Panchora estate in the Nilgiri-Wynaad, Maniyankode estate in the Malabar-Wynaad, Huvinkad estate in South Coorg, Cheekanahalli and Harley estates in Saklespur, Bettadamane and Banakal estates near Mudigere (Mysore State) representing different soil climatic zones in South India where robusta coffee is grown.

In these trials, plant foods Nitrogen, Phosphoric acid and Potash are being given in the proportion of 40-30-40, 60-30-40, 60-45-60, 60-60-80 and 40-60-80 lb. to the acre of 680 plants planted 8′ × 8′. Nitrogen is applied as ammonium sulphate in 3 doses and phosphate and potash as hyperphosphate and muriate of potash respectively in 2 doses. The experiment is laid out in 6 × 6 latin square with 5 × 4—20 plants in a nett sub-plot. A basal dressing of 10 cwt. of rock phosphate/acre has been applied to the entire area.

(d) N.P.K. trials on robusta

In order to find out the effect of the three major plant nutrients—Nitrogen, Phosphorus and Potash—on the growth and yield of mature robusta coffee, trials were laid out in the estates mentioned under the Modified Field Trials above. Six treatments: N only, N + P, N + K, P + K, N + P + K and Control (no treatment) with constant levels of N, P and K at 60 lb. 45 lb. and 60 lb. respectively to the acre are being tried. The plan and layout of the experiment are same as for the Modified field trials.

(vi) Studies on the foliar feeding of plant nutrients

(a) Exploratory trial on the effect of foliar applications of plant foods to coffee in relation to growth and yield

The experiment started in 1955 was concluded. The treatments were not significant.

The trial was modified and laid out at the Coffee Research Station, Balehonnur, in May 1956. Leaf samples were collected before and after the treatment to study the extent of uptake of nutrients through leaf surface. The following are the treatments imposed:

Treatments

A. (N_1). 20 lb. nitrogen per acre as urea solution sprayed.
B. (N_2) 40 lb. ,, ,,
C. (N_1P_1). Treatment A+15 lb. P_2O_5 as super phosphate.
D. (N_2P_2). Treatment B+30 lb. P_2O_5 as super phosphate.
E. (N_1K_1). Treatment A + 20 lb. K_2O as muriate of potash in solution and sprayed.
F. (N_2K_2). Treatment B+40 lb. K_2O ,,
G. ($N_1P_1K_1$). Treatment C+20 lb. K_2O per acre as muriate of potash in solution and sprayed.
H. ($N_2P_2K_2$). Treatment D + 40 lb. K_2O per acre as muriate of potash in solution and sprayed.
I. ($N_0P_0K_0$). No treatment (Control).
J. ($N_0P_0K_0$). Plain water sprayed (check on water used in spray)

Yields will be recorded and statistically analyzed.

(b) **Exploratory trial on the effect of essential minor and major elements**

The experiment started in October 1954 was continued. There was no response to treatment.

(vii) **Experiments on the response to manuring of coffee seedlings in the nursery**

(a) **Comparative trials using Rapidgro and other nitrogenous fertilizers**

This experiment started in April 1955 was concluded in November 1955. The details of this experiment were given in the Report for 1954-55.

Measurements of the height, leaf population and initiation of primaries were made on 5 tagged seedlings selected at random at monthly intervals commencing from 24th April 1955 and continued upto the time of removal for planting in the field in September 1955. Three seedlings out of each replication were retained for further studies in the laboratory. The results of the experiment are given in Appendix XXIX.

It would appear from an examination of the data at the end of 16 and 20 applications, that treatments with Rapidgro and nitro-phosphate produced significantly greater increase in height of seedlings than other treatments indicating that full fertilizer is best for growth; nitrogen in combination with phosphate both in easily available forms would be beneficial; nitrogen in the form of urea appears to be better than other forms; repeated applications of chilean nitrate only are harmful; ammonium sulphate would be better than ammonium nitrate to promote growth and application of cowdung extract only to seedlings growing in a rich medium is not beneficial.

(b) **Comparative trials using trace element preparations and urea foliar spray**

This experiment started in April 1955 was continued and concluded in 1955 when the seedlings were planted out into the field. Observations were continued even after planting in the field for a period of three months although application of treatments had ceased by the beginning of September. The details of the experiment were given in the Report for 1954-55. Measurements of the height, the leaf population and the initiation of primaries were made on tagged seedlings selected at random at monthly intervals commencing from the 26th April 1955 and continued up to the time of removal for planting in the field. The results of the experiment are given in Appendix XXX.

The treatments have not been significant. However indications are that plants sprayed with Nu-iron in urea solution establish better.

(c) **N.P.K. trials with varying levels and combinations**

This experiment was started in June 1956 to find out the essential requirements of plant foods N, P & K for good growth of arabica seedlings. Following are the details:

Treatments: Main 27—3 levels each of N, P & K in all possible combinations.

Sub-treatments: 2×2=4 in each main treatment due to variation in soil medium.

Gross 108.

Main treatments combinations	*Symbol*	*Main treatments combinations*	*Symbol*
1. $N_0 P_0 K_0$.	H	14. $N_1 P_1 K_1$.	B.
2. $N_0 P_1 K_0$.	π	15. $N_1 P_2 K_1$.	E.
3. $N_0 P_2 K_0$.	J.	16. $N_1 P_0 K_2$.	O.
4. $N_0 P_0 K_1$.	X.	17. $N_1 P_1 K_2$.	K.
5. $N_0 P_1 K_1$.	P.	18. $N_1 P_2 K_2$.	N.
6. $N_0 P_2 K_1$.	G.	19. $N_2 P_0 K_0$.	T.
7. $N_0 P_0 K_2$.	L.	20. $N_2 P_1 K_0$.	D.
8. $N_0 P_1 K_2$.	A.	21. $N_2 P_2 K_0$.	Y.
9. $N_0 P_2 K_2$.	Z.	22. $N_2 P_0 K_1$.	I.
10. $N_1 P_0 K_0$.	V.	23. $N_2 P_1 K_1$.	R.
11. $N_1 P_1 K_0$.	F.	24. $N_2 P_2 K_1$.	C.
12. $N_1 P_2 K_0$.	S.	25. $N_2 P_0 K_2$.	U.
13. $N_1 P_0 K_1$.	Q.	26. $N_2 P_1 K_2$.	M.
		27. $N_2 P_2 K_2$.	W.

Where N_0=Nil nitrogen.

N_1=0.5 gms of urea (46 per cent N) per plant per application (12 lb. nitrogen for 1,200 seedlings in 20 weekly applications).

N_2=1.0 gms of urea (46 per cent N) per plant per application (24 lb. nitrogen for 1,200 seedlings in 20 weekly applications).

P_0=Nil phosphoric acid.

P_1=0.5 gms of Hyper phosphate Reno (30 per cent P_2O_5) per plant per application (7.5 lb. phosphoric acid for 1,200 seedlings in 20 weekly applications).

P_2=1.0 gms of Hyper phosphate Reno (30 per cent P_2O_5) per plant per application (15 lb. phosphoric acid for 1,200 seedlings in 20 weekly applications).

K_0=Nil potash.

K_1=0.4 gms of Muriate of potash (60 per cent K_2O) per plant per application (12 lb. potash for 1,200 seedlings in 20 weekly applications).

K_2=0.8 gms of muriate of potash (60 per cent K_2O) per plant per application (24 lb. potash for 1,200 seedlings in 20 weekly applications).

Sub-treatments

Each of the main treatments is imposed on (1) plants growing in ordinary top soil and (2) plants growing in prepared soil made up of two parts of top soil from jungle, one part of compost (made of coffee fruit skins, urea and rock phosphate) and one part of river sand.

One half of each of the above two soil types are limed at the rate of 1 lb. of agricultural lime for every 1,000 lb. of soil—once before planting the seedlings and later again if necessary.

This results in the following four sub-treatments viz.,

1. Main treatment in ordinary soil unlimed.
2. Main treatment in ordinary soil limed.
3. Main treatment in prepared soil unlimed.
4. Main treatment in prepared soil limed.

Treatments are imposed on seedlings planted in wooden boxes filled with soil.

Plot size: 6×6=36 seedlings are planted 9″×9″ for each main treatment in one box with 3×3=9 seedlings for each of the sub-treatments in each quarter of one box.

Replications: 3. *Lay out:* Randomized.

Time and Method of applications: The different fertilizers are dissolved dispersed in water and applied to the soil around each individual seedling once in a week.

Observations: 1. Growth measurements before imposing the treatments and at periodical intervals thereafter.

2. Periodical laboratory study including recording of fresh and dry weights of whole plants, leaves, stalk and roots, thickness of stalk at the collar region, leaf area and chemical analysis of individual parts.

3. Initial and later periodical analyses of soils for chemical, mechanical and structural factors and base status.

B. Cultural experiments

(i) Studies on growth and yield of coffee in relation to shade requirements—Hedge row system of planting

The experiment started in 1953 was continued. The flower buds on the brown wood has been allowed to stay and that on green wood rubbed off.

In the month of January 1956 two soil moisture tensiometers were installed one in the unshaded portion and the other in a corresponding spot in the shaded part. Wet and dry bulb thermometers and soil thermometers were also fixed in close proximity to the soil moisture tensiometers. Observations on soil moisture tensions, soil temperatures, atmospheric temperatures and humidity were regularly recorded thrice in a day between 8 to 8.30 a.m., 1.30 to 2 p.m. and 4.30 to 5 p.m., commencing from 24-1-1956. The data will be discussed in detail after completion of one year's observations. The following general trends are noted:

(1) There was very little difference in the atmospheric temperature between the shaded and unshaded portions in the morning and in the evening; the temperature was always higher in the open than under shade during the afternoons.

(2) Average humidity was higher in the shaded portion than in the unshaded portion.

(3) Soil moisture readings showed considerable variations between the shaded and open portions, the tension being invariably higher under shade indicating a greater removal of water. Reduction of moisture tension on receipt of summer rains was much quicker in the open than under shade indicating that not all the rain falling on shaded area reached the soil, part of it being caught by the shade canopy and evaporated. The shade trees also may be consuming and transpiring a large portion of the available soil moisture so that at critical stages coffee plants may suffer from moisture competition. Plants in the open stand to benefit more from small rainfalls than those under shade as practically all of the water reaches the soil. When

monsoon set in, moisture tension under shade was reduced to nil while in the open there was a slight tension maintained indicating better movement of water and aeration attending it.

(ii) Studies on fruit set in coffee

Observations carried out in previous years on the setting of flowers to fruit and their final harvest have shown that there is a large loss usually between the actual number of flowers that opened and that which is harvested as fruit. In the usual leaf disease susceptible arabica coffee, this loss amounts to about 65 per cent on the average, in the leaf disease resistant types to about 58 per cent and in the case of robusta 48 per cent.

The question of reducing this loss has been engaging the attention of the Department for quite a while now. In 1948, 1949 and 1950 experiments were carried out using hormone sprays for which claims had been made that they would prevent dropping of fruits. The treatments were not successful in preventing fruit drop.

Messrs Naugatuck Chemical International of New York through their Agents Messrs Bombay Chemicals Ltd., Bombay, suggested that their preparation *Duraset 20 W* (a flower and fruit setting hormone, N-metatolyl phthalamic acid) may prove useful as it had successfully helped in better setting of fruit in the case of lima beans, tomatoes, pepper, lupines, soya beans, apples, pears, cherries and peaches. Trials were started both on arabica and rubusta in March 1956. The details are given below:

Treatments: 9×3=27.

Three strengths of Duraset 20 W as a spray in water dispersion, three strengths as dust in talc base, plain water, plain talc and untreated control—each applied at three different times viz., soon after blossom showers, on the blossom and petal fall.

	Treatments	*Symbol*
1.	Duraset 20 W.—½ lb. in 100 gallons of water sprayed soon after blossom showers to give full coverage of plants	A
2.	Duraset 20 W.—1 lb. in 100 gallons of water ,, ,,	B
3.	Duraset 20 W.—2 lb. in ,, ,,	C
4.	Duraset 20 W.—0.13 lb. (60 gms) in 100 lb. talc dusted to give full coverage of plants	D
5.	Duraset 20 W.—0.26 lb. (120 gms) ,, ,,	E
6.	Duraset 20 W.—0.52 lb. (240 gms) ,, ,,	F
7.	Plain water used for making above solutions and sprayed	G
8.	Plain talc used for making above dusts, dusted	H
9.	Untreated (Control)	
10—18.	Treatments 1 to 9 respectively applied on the blossom in the afternoon after a lapse of 6 hours after blossom has opened	A_2 to H_2
19—27	Treatments 1 to 9 respectively applied at petal fall—roughly 2 to 3 weeks after blossom	A_3 to H_3

Replications: 3. *Layout:* Randomized.

Plot size: Single plants of uniform growth and situation chosen at random, constitute each sub-plot. (4 years old S.795 in the case of arabica and 5 years old S.274 in the case of robusta).

Time and method of application: As indicated earlier.

Observations: 1. Three uniform branches, newly cropping with the number of bearing nodes and leaves not widely

varying, are tagged and the total number of buds before blossom and the berries after set in each node of each branch counted at periodical intervals till the crop is harvested.

2. The total crop in terms of fresh cherry and clean coffee from each sub-plot is recorded.

The initial count of original number of buds produced and a subsequent count after set have been taken.

C. Laboratory

Work in the laboratory consisted mainly of analysis of soil, plant and manure samples sent by planters and those collected by the division. Analyses of soils, leaf and petiole samples from the New Manurial Series, and of the soil profiles collected were completed.

(a) Analysis of coffee leaves and petioles collected from the New Manurial Series

Leaf and petiole samples were collected at the end of each calendar month from January 1952 to January 1954 from plants under experiment in the New Manurial Series and analysed for total nitrogen, phosphoric acid, potash, lime and carbon nitrogen ratios to study the effects of the differential manuring on mineral composition of plants at different periods of their activity and growth. The methods of collection, preparation and analysis of samples have been described in detail in the Annual Report for 1952-53.

No significant difference due to any of the treatments could be noticed. In general, variations in leaf and petiole nitrogen corresponded with specific physiological phases in the activity of the plants viz., blossom and fruit set, swelling of berries and ripening. Phosphoric acid content of leaves and petioles also indicate a correlation with physiological processes whereas potash and lime do not do so. The C/N ratios of leaves were wide in the pre-blossom and post-monsoon periods. The various analytical values for corresponding months or periods of the two years are not strictly of the same pattern and the differences are traceable to climatic variations and the quantity of the crops before, during and after the seasons under consideration. Judged from the figures fixed by Brazilian analysts as critical limits for deficiency levels, the present analysis shows that in India, coffee plants are well above such deficiencies.

(b) Analysis of coffee seedlings from the experiments on the response to manuring in the nursery

Selected seedlings from each sub-plot of the comparative trial using Rapidgro and other nitrogenous fertilizers were analysed for fresh and dry weights of whole seedlings, and parts thereof viz. leaves, stalks and roots, lengths of stalks, girths of stalks at collar region, total leaf area, fresh and dry weights per unit area of leaf and chemical analysis for nitrogen in unit leaf area and nitrogen and organic carbon percentage and penultimate in whole seedlings and parts thereof.

The results are furnished in Appendix XXXI.

The treatments with Rapidgro and urea produced greater fresh and dry weights of whole seedlings as well as parts and greater stalk length and girth than other treatments. Treatment with Nitrophosphate also was effective in this respect and was significantly superior to control in fresh and dry weights. Treatments with Ammonium nitrate and urea produced the greatest fresh weight and moisture per unit leaf area. Treatments Cowdung extract, Control and Chilean nitrate are the lowest in the order stated in all determinations and treatment with Chilean nitrate is invariably significantly inferior to the rest.

In the chemical analysis, treatments with Ammonium sulphate contained the highest percentage of nitrogen in whole seedlings, leaves and stalk while treatment Control the lowest on fresh weight basis; treatment Chilean nitrate contained the lowest concentration of nitrogen in roots. On dry weight basis, Control had the lowest percentage of nitrogen in all cases while treatment Ammonium nitrate was the highest in whole seedlings, treatment Chilean nitrate in leaves, and treatment Ammonium sulphate in stalks and roots. In the calculated nitrogen recovered in whole seedlings and parts, treatments Cowdung extract, Control and Chilean nitrate were the lowest in the order mentioned. treatments with Chilean nitrate was significantly inferior to the rest in all cases except stalk. Treatments with Urea and Rapidgro were the highest in whole seedlings, leaves and stalks, while in roots, treatments Rapidgro and Ammonium nitrate came first.

Treatments with Ammonium sulphate gave the highest percentage of organic carbon on fresh weight basis in whole seedlings, leaves and stalks while in roots, treatment with Ammonium nitrate was the highest. Treatment with Chilean nitrate had the lowest in all cases except stalks where treatment with Rapidgro was the lowest. On dry weight basis, treatment with Ammonium sulphate gave the highest percentage of organic carbon in whole seedlings and leaves, treatment Urea in stalks and treatment Ammonium nitrate in roots. Treatment Control had the lowest in whole seedlings, stalks and roots while treatment Urea was the lowest in leaves.

The calculated organic carbon recorded in whole seedlings and in parts was the highest in treatments with Rapidgro and Urea and the lowest in Cowdung extract, Control and Chilean nitrate in the order stated.

Treatment Control had the widest C/N ratio in whole seedlings, leaves and stalks closely followed by treatments Nitrophosphate and Cowdung extract while in roots treatment with Chilean nitrate had the widest followed by Control and Nitrophosphate.

In nitrogen per unit leaf area, treatment with Urea gave the highest content followed by treatments Ammonium sulphate, Nitrophosphate, Chilean nitrate, Rapidgro, Cowdung extract and Control.

Summarising the above, it may be inferred that nitrogen in Urea form is very effective in promoting growth of coffee plants and this beneficial effect is augmented by addition of adequate quantities of phosphate and potash. Repeated application of Chilean nitrate only hinders growth.

Interactions between the several factors determined and their significance are being studied.

(c) Analysis of soil profiles collected from Hassan area (Mysore State)

Soils collected profilewise in 1952 from various estates in Hassan area for studying typical characteristics and variations in composition have been analysed. The description of the profiles was given in the Annual Report for 1951-52.

Generally all the soils studied are loams, mostly neutral to slightly acid with a number of instances with typical symptoms of leaching and base depletion in upper layers. The soils from the drier areas were found to be richer in total bases and had less sesquioxides than those in wetter regions, indicating a correlation between rainfall and base status. An increase in sesquioxides in lower layers was discernible in many cases indicating laterization. Top layers are invariably well up in total nitrogen and organic matter while total and available phosphoric acid are either low or poor, especially the latter, with a gradual reduction with depth. Total potash is found higher in lower layers than in the top soils and great variations in available potash are noticed. From an analysis of the ignited clay, the soils can be broadly classified under the types Tropical Red Earths, Brown Earths and Terra Rosa.

(d) **Analysis of soils from Karadibetta estate (Saklespur, Mysore State)**

Analyses of the 72 samples collected in 1953 from Karadibetta estate have been completed. In general, the soils are sandy loams with a tendency to become clayey at lower depths. They are generally very poor in total phosphoric acid. Available phosphoric acid and potash are very low. Total potash is fair to good. Total lime and magnesia are fairly high. The soils are all slightly acid and well within the range needed for good growth of coffee.

(e) **Soil samples from the 17-acre Manurial experiments 1952 series (N.P.K. trials with varying levels of nitrogen with constant levels of P.& K.)**

Fifty samples from the 25 plots in the above experiment were collected from the 0-9″ and 9″-18″ layers before the application of treatments in August —September 1952, and analysed in order to assess the initial fertility of the plots. On the whole the plots are fairly uniform.

(f) **Analysis of soil samples from the arabica manurial (N.P.K. trials with varying levels and combinations) experiments at the Coffee Research sub-station, Chethalli**

One hundred and forty four samples from the 48 plots in the above experiments were collected from the 0-9″, 9″-18″ and 18″-27″ layers before application of treatments in August—September 1953 and analysed in order to assess the initial fertility of the plots.

The chemical analyses have been completed and the mechanical analyses are under way.

(g) **Seasonal variations in the availability of phosphoric acid and potash in coffee soils**

Soil samples from the top 6″ layer from six selected plots of the New Manurial Series Experiment under different treatments viz., N, NP, NK, NPK and Control limed to requirement and another plot under treatment NPK which did not require any lime, were drawn at intervals of 10 days starting from April 1954 and continued till June 1955 and analysed for moisture, pH values, total nitrogen, C/N ratios and available phosphoric acid and potash. The data indicate the following:

pH values are usually between 6.5 and 7 in all treatments with a decrease to 6.0 to 6.5 during October—November. Available phosphoric acid was invariably higher in plots treated with phosphate. The availability varied considerably in the season with a peak during summer without any marked difference between the limed and unlimed plots. There was a drop in availability corresponding to the decrease in pH values noticed during the commencement of winter. There was not much difference due to treatments in the available potash. During the period November—December, there was a marked drop in available potash in all plots. Total nitrogen is of the same order in all plots and a drop is noticeable in the period October—November.

Organic carbon and C/N ratios vary within narrow limits and do not form a regular pattern.

In general the trend of the results points to a rough correlation between pH and availability of phosphoric acid and applications of phosphates and available phosphoric acid contents. Indications are that phosphates in the form of finely ground rock phosphate have been effective.

(h) Seasonal variations in the availability of Phosphate and potash in coffee soils under different shade trees

A study has been started in June 1956 to find out the seasonal variations in the availability of phosphate and potash and exchangeable bases in coffee soils under six shade trees commonly grown viz. *Albizzia stipulata*, *Artocarpus integra*, *Bischofia javanica*, *Erythrina lithosperma*, *Grevillea robusta* and *Ficus glomerata* having different foliage characteristics. Top 6" layer soil samples are being collected at monthly intervals from three locations from the Balehonnur area i.e. (1) Coffee Research Station, (2) Guntanaik estate and (3) Shegode estate, and are being analysed. The study is planned to be carried out over a 13-months' cycle in the first instance.

(i) Studies in the uptake of plant nutrients and seasonal variations

A study was commenced in January 1955 to find out the seasonal variations in the uptake of plant nutrients under differentially treated conditions.

Tissue and soils from the plants and plots in the New Manurial Series experiment are being tested every fortnight using a field soil test out-fit. For testing tissues, the morning hours between 9 and 11 have been found suitable and the petiole of the third leaf from the apex of a central branch is found to be indicative of providing a standard test material.

A reduction in the nitrate status of petioles and soils has been observed during the period following blossom showers. There is an immediate response to nitrogen application at this stage. Tests for ammonia and nitrate in soil indicate that urea takes only 3 weeks to get converted to these forms of soil nitrogen. Further work is in progress.

(j) Analysis of compost from cherry skins

Coffee cherry skin was composted with urea, ammonium sulphate, ground rock phosphate and fishmeal and the composts resulting at the end of 3 months were analysed. It was observed that addition of urea, ammonium sulphtae and rock phosphate increases the rate of breakdown in addition to enriching them in mineral contents.

(k) Processing of coffee

Exploratory trials to eliminate the 'fruity' flavour in *cherry* coffee have been undertaken. Washing of the fruits before drying, washing the beans in cold and hot water, alkali, acid, permanganate and bisulphite has been tried. Cup tasting reports on the initial samples have not given any indications. Further studies are being carried out.

D. Advisory

Soil samples from 5 estates in Mysore, two in Coorg, three in Nilgiris, two in Anamalais and two from Assam totalling 89 samples were analysed. Samples of composts from cherry skins, cattle manure and the sludge from anaerobic fermentation of cowdung (Gramaluxmi plant) were analysed.

A case of clay pan formation resulting in bad drainage and consequent suffering of coffee plants from excessive wetness in the rainy season and want of moisture in the dry months and causing nutritional insufficiency and imbalance, was detected.

The number of determinations carried out during the year was:

1.	Moisture	508	15.	Water soluble P_2O_5	30
2.	Loss on ignition	301	16.	Water soluble K_2O	30
3.	Insoluble residue	275	17.	Total solids	30
4.	pH values	1020	18.	Ash	32
5.	Organic carbon	430	19.	Sesquioxides	190
6.	Total nitrogen	525	20.	Iron Oxide	55
7.	Total P_2O_5	515	21.	Lime requirement	64
8.	Total K_2O	317	22.	Free lime	3
9.	Total CaO	267	23.	Mechanical analysis	700
10.	Total MgO	18	24.	Clay analysis	165
11.	Total exchangeables	91	25.	Leaf area	31
12.	Available P_2O_5	217	26.	Soil and Tissue tests with field testing outfits	
13.	Available K_2O	193		(a) Tissue tests	625
14.	Water soluble nitrogen	30		(b) Soil tests	3678
				Total	10340

Experiments at the Coffee Research Sub-station, Chethalli (Coorg)

1. *N.P.K. trials with varying levels and combinations: Arabica*

This experiment described in para A. (ii) (f) above was in progress.

2. *Field manurial trials on arabica*

This experiment—one among the ten—described in para A. (iv) above was in progress.

3. *Studies on the effect of Aldrinised fertilizers on yield of coffee*

This experiment described under para A. (ii) (g) above was started and is in progress.

4. *N.P.K. trials with varying levels and combinations—Robusta*

This experiment described in para A. (v) (a) above was in progress.

5. The experiment on catalyzation of plant nutrients was discontinued.

6. One exploratory test-scale trial on arabica on the application of varying doses of nitrogen with constant levels of phosphate and potash started in 1954 was continued. No differences could be noticed in the yields.

7. A manurial demonstration plot was laid out in old robusta to demonstrate the effects of manuring with nitrogen alone and in combination with phosphate or/and potash.

8. Twenty-four samples from 6 estates in Coorg area were tested for advisory purposes.

N. G. Chokkanna
Chemist

IV. ENTOMOLOGY

Studies on the Coffee stem borer (*Xylotrechus quadripes* Chev.) and Green bug (*Lecanium viride G.* and *Coccus colmani* Nov. sp.) on arabica, Shot hole borer (*Xyleborus morstatti Hagdn.*) on robusta and Eelworm (parasitic on coffee) formed the main pre-occupation of the Section.

Concurrent studies were undertaken to explore separate and integrated techniques for evolving economic measures of both chemical and biological control. Laboratory and field trials were directed to study the efficacy and residual toxicity of insecticides and the economics of such methods of control. Chlorinated hydrocarbons, Organo-phosphorus compounds (including systemic insecticides), chlorinated camphene and mineral oil were tried.

The preliminary survey on the incidence, periodicity and seasonal intensity of pests at the Research Stations and the several coffee zones was continued with the cooperation of the liaison staff and generous response of the planters to enable regularizing of effective control programmes. The Division also attended to routine examination of material for advisory work and visit to problem areas for investigation and advice on pest control.

A. Field Experiments

1. Insecticidal control of Coffee stem borer (Xylotrechus quadripes Chev.)

Experiments started during 1953 and early part of 1954 were continued to study the relative efficacy of B.H.C. formulations, D.D.T., Dieldrin, Aldrin, Chlordane, Chlorinated Camphene and Folidol E-605. In these experiments, different dilutions of insecticides in water were swabbed on to the main stems and thick primaries of coffee, once in April—May and twice in October—December, coinciding with the two borer flight seasons. Counts of healthy and infested (bored) plants were made at monthly intervals and the effect of treatments was evaluated.

Experiment I

The experiment to compare the relative efficacy of B.H.C. and its formulations, combinations of B.H.C. and D.D.T., and Folidol E. 605, started in 1953 was continued.

Details of observations recorded are furnished in Appendix XXXII. It was noticed that except dust, all other B.H.C. formulations had consistently given an effective control of the stem borer. It is however noticed that the continued applications of B.H.C. all over the estate over 8 seasons had definitely reduced borer infestation in general.

Experiment II

The experiment to compare the efficacy of B.H.C. with Chlordane and Toxophene started in October 1953 was continued.

Details of observations recorded during the year are furnished in Appendix XXXIII. It is again observed that B.H.C. 50 per cent W.P. formulation at 1 per cent active concentration has given more effective control than the other pesticides under test.

Experiment III

The experiment started in 1954 to test the comparative efficacy and greater lasting effect of formulations of Aldrin and Dieldrin (chlorinated cyclo-pentadiene derivatives) against that of Benzene hexa chloride formulations was continued during the year.

Aldrex-2 and Dieldrex-15 (formulations of Aldrin and Dieldrin respectively) at 0.5 per cent active concentration were applied twice—once in each of the two borer flight seasons—and B.H.C. 50 per cent W.P. thrice during the year—once in April—May and twice in October—December borer flight seasons.

A summary of observations recorded are given in Appendix XXXIV. It would appear as though two applications of the Dieldrin formulation are as effective as 3 applications of B.H.C. for controlling the Coffee stem borer.

Experiment IV

The exploratory trials conducted during the previous year to determine the relative residual toxicity of different concentrations of Dieldrin and Aldrin formulations, combinations of B.H.C. and D.D.T. and B.H.C. alone, were repeated during the current year for confirmation of the results indicated earlier.

The following concentrations of the insecticides were used:

B.H.C. 50 per cent W.P. 1 per cent
B.H.C. 50 per cent W.P.+D.D.T. 50 per cent 1 per cent
Dieldrin—0.125 to 0.5 per cent
Aldrin—0.125 to 0.5 per cent

(a) Cut stems of coffee were swabbed with the above insecticides and kept under glass jars with wire gauze covers in the laboratory.

(b) Insecticides were swabbed on to stems of selected plants in the field and the stems jacketted with wire gauze.

Commencing from the 26th day after swabbing, live beetles of stem borer were released at weekly intervals on to the treated stems in both cases till the 69th day from start.

Observations were made on period of activity, inclusive of oviposition and mortality. It was found that the treatment was lethal over a period of 33 days in the case of B.H.C. 1 per cent with or without D.D.T. and Dieldrin at 0.125 and 0.25 per cent active concentrations; at higher concentrations of Dieldrin (0.4 and 0.5 per cent) the lethal effect lasted as long as 54 days in the laboratory. The beetles failed to oviposit. These observations confirmed the results of previous year's observations. In the field trials, the beetles released on the treated plants were observed to be active for a long period even from the first release onwards (26 days' interval). This may possibly be due to heavy showers (7.7 inches) received during the first fortnight following the application of insecticides which would appear to have reduced the toxic effect of insecticides.

Further evaluation of the cost of protection and the standardization of the time and method of application is in progress.

Experiment V

Earlier trials at the two Research Stations had indicated that Dieldrin, B.H.C. and Chlordane at varying concentrations were equally effective in controlling stem borer incidence and that Dieldrin applied twice a year, at one application in each flight period, was as effective as the higher concentrations of the pesticides under test. Moreover, it was equally effective as three applications of Chlordane or B.H.C. formulations.

The trials were extended during October 1955 to a field scale test in a private estate to test the residual lasting effect of Dieldrin applied thrice in the same manner as the other two test material.

The plants were swabbed once in April and once in October where two applications were made, and once in April, and again in early October and one month thereafter where three applications were made in the year.

Population counts of healthy and borer infested plants were taken four times in the year, at the commencement of the flight and before and after applications of the insecticides were made.

The lay out and details of treatment are summarised below:

Locality: Shegode Estate, Balehonnur (Mysore state)
Lay-out: Randomized block. *Replications:* 4.
Plot size: 4 rows of 25 plants=100 plants for each sub-plot.
Total area under experiments: 3.00 acres.

Treatments: 11.

A.	Control (no treatment).	
B.	B.H.C. 50 per cent W.P-1 per cent ac.	3 applications per year.
C.	Dieldrin W.P-0.25 per cent ac.	2 applications per year.
D.	,, ,,	3 applications per year.
E.	,, 0.125 per cent ac.	2 applications per year.
F.	,, ,,	3 applications per year.
G.	Dieldrex—15 0.25 per cent ac. (emulsion con.)	2 applications per year.
H.	,, ,,	3 applications per year.
I.	,, 0.125 per cent ac.	2 applications per year.
J.	,, 0.125 per cent ac.	3 applications per year.
K.	Chlordane 0.09 per cent ac. (emulsion con.)	3 applications per year.

The experiment is in progress.

Experiment VI

Trials with systemic insecticides for the control of Coffee stem borer

Of recent years considerable evidence is to be had of effective control of pest infestation by the use of a new group of insecticides—systemic insecticides. The insecticides are absorbed by the plants and such plants are rendered toxic to insects which feed on them. Bugs, aphids and such other insects feeding on treated plants are reported to be killed by the toxic effect. It is also known that the concentration of these insecticides is of an infinitely small order.

In the previous year, exploratory trials were undertaken to find out the effect of proprietary systemic insecticides viz., Sytam, Pestox, Tetrax and Systox at active concentrations varying from 0.1 to 0.5 per cent against Coffee stem borer.

Since the concentrations used were not effective, concentrations of 1.5 per cent of Pestox, Tetrax and Systox were tried. In addition Metasystox was also taken for tests during the current year. The insecticides were injected into the coffee stems. The treated stems were split open at fortnightly intervals and examined to observe the effect of the insecticides on the larvae. The insecticides did not indicate any effect on the insects even after 3 months from treatment.

2. **Studies on the control of Green bug on coffee: (Lecanium viride** G. and **Coccus colmani** Nov. sp.)

Experiment I

Comparative trials on the use of Organic pesticides against Green bug

An exploratory trial was started in March 1956 to compare the relative efficacy of Ekatox '20' W.P., Folidol E-605 and White Oil emulsion against Green bug.

The treatments were:

A. Folidol E-605 0.02 per cent.
B. Ekatox '20' W.P. 0.1 per cent
C. White oil emulsion 2. 5 per cent*
D. Control.

*White oil emulsion was prepared using 1 part of Lissapol for 150 parts of White oil.

4 plants were taken for each treatment. An estimate of the population of Green bug was made before spraying (initial) and finally after a period of 2 weeks from spraying. 2 leaves from each of the plants were taken at random and the population of bugs on these was determined. The data are given below:

Treatments	Initial population	Population 2 weeks after	Percentage reduction (—) or increase (+)
A.	471	39	—91.7
B.	283	23	—92.0
C.	524	63	—88.0
D.	320	447	+40.0

It is seen that both Folidol and Ekatox are almost equally effective and slightly superior to White oil emulsion in controlling the pest.

Experiment II

Comparative trials on the use of different Organophosphorus insecticides against Green bug

In earlier preliminary trials, Folidol E-605 was found to be effective in the control of Green bug. These trials were extended to a private estate (Merthikhan) where the pest incidence was high in order to confirm the earlier findings.

An experiment was started in April 1956 with 5 treatments replicated four times at random, having five plants under each treatment. The treatments were:

A. Folidol E-605—0.02 per cent
B. Folidol E-605—0.015 per cent
C. Ekatox '20' W.P-0.1 per cent
D. H.E.T.P-0.125 per cent
E. Control (no treatment)

Four sample leaves from two plants were selected at random and counts on population of bugs were taken prior to imposition of treatments and at weekly intervals for two weeks thereafter and finally after the fifth week from spraying. The data of observations are furnished in Appendix XXXV.

It is seen that all the insecticidal treatments have been effective in reducing the pest population appreciably even as early as the first week after application and that this effect persists over the next week. There is thereafter a gradual re-infestation, the pest doubling itself at the end of the five week period. Further trials are in progress to determine the period at which re-infestation occurs and the periodicity of protective treatments to achieve maximal reduction in attack.

Experiment III

Comparative trials on the efficacy of Organic pesticides with and without Bordeaux against Green bug

In seasons when protective measures against Green bug and Leaf disease are to be taken simultaneously, Ekatox '20' is mixed with Bordeaux mixture and used. Folidol E-605 may also be combined with Bordeaux mixture and used for similar purposes. To find out the extent of reduction, if any, in efficacy

and to arrive at economic and effective concentrations of Ekatox and Folidol in combination with Bordeaux mixture for use against Green bug, an exploratory trial was undertaken in April 1956. The following concentrations of the insecticides were tested with and without Bordeaux mixture.

A.	Ekatox '20' W.P.	0.1 per cent without Bordeaux mixture.
B.	,,	0.05 per cent ,,
C.	Folidol—E. 605	0.02 per cent ,,
D.	,,	0.015 per cent ,,
E.	Ekatox '20' W.P.	0.1 per cent with Bordeaux mixture.
F.	,,	0.05 per cent ,,
G.	Folidol—E. 605	0.02 per cent ,,
H.	,,	0.015 per cent ,,
I.	Control.	

One plant was taken for each treatment. An estimate of the populations of Green bug was made before spraying (initial) and finally 2 weeks from spraying. 2 leaves of similar age having almost uniform infestation were taken from each plant for estimating the population and the effect of treatments on bugs. The data are furnished below:

Treatments	Population of Green bug		Percentage reduction (—) or increase (+) from Initial
	Initial	2 weeks after (Final)	
A.	130	5	(—) 96.1
B.	62	13	(—) 80.1
C.	149	8	(—) 94.6
D.	131	7	(—) 94.6
E.	56	12	(—) 80.0
F.	149	43	(—) 71.2
G.	118	10	(—) 91.5
H.	181	38	(—) 79.0
I.	46	267	(+) 480.4

It is seen that in the control of Green bug, both the concentrations (0.015 per cent and 0.02 per cent) of Folidol-E.605 and 0.1 per cent concentration of Ekatox are more effective when not in combination with Bordeaux mixture. Addition to Bordeaux mixture seems to lower the efficacy of the insecticides under trial at these concentrations.

Experiment IV

Trials with systemic insecticides

Exploratory trials with this group of new insecticides were continued during the year.

Pestox-3 was tested for its action on Green bug when used as a foliar spray. 0.4 per cent Pestox was sprayed on half the number of twigs of Green bug infested plants to study if the insecticide is absorbed by the treated leaves, and translocated to the unsprayed parts rendering them toxic to the bugs infesting on them. Two leaves were taken from the sprayed and unsprayed twigs to observe the toxic effect of the insecticide on the bugs. Green bug population was estimated before spraying (initial) and later twice at weekly intervals and finally after a month from spraying. In the unsprayed plants which were kept as control, population studies were made at the corresponding periods.

Following are the details:

Treatments: 2. 9 plants for each treatment.
Started in February 1956.

	Treatments	Initial	1 week after treatment	2 weeks after treatment	A month after treatment
A	1. Pestox-3-0.4 per cent sprayed part of the plant	1321	173	263	129
	2. Unsprayed Part of the plant	2509	2270	3096	4234
B.	Control	2040	3263	4117	4932

There was a reduction in the bug population in the sprayed part whereas on the unsprayed part of the same plant and in the control there was an increased infestation. It would appear that Pestox-3 at 0.4 per cent concentration has a highly effective contact action but its systemic effect on the Green bug infesting the unsprayed part of the same plant is not evident.

Experiment V

In this experiment systemic insecticides, Systox, Tetrax, and Metasystox, at 1.5 per cent concentrations were used. 4 plants were taken for each treatment and 25 c.c. of the solution were used per plant.

Application of the insecticides was made by employing the 'Binding method'. Absorbant cotton (4" wide) soaked in 1.5 per cent solution of the insecticide was wrapped around the main stem of the plant and covered by an impermeable material (alkathene) to prevent evaporation of the insecticide.

Population of green bug was recorded on three leaves at random from each plant, once before the application of the insecticides and again on the 8th, 16th and 30th day from the date of application. The trial was carried out in May 1956. The data are given in Appendix XXXVI. It would appear that both Systox and Metasystox were equally effective in controlling Green bug. The toxic effects of these insecticides were noticed on nymphs and adults after 8 and 16 days respectively from application. Mortality of the bugs was noticed at each stage of observation. There was a steady increase in the mortality of Green bugs. Tetrax was not as effective as the other insecticides tested.

Indications are that the insecticides applied on the stem are absorbed and translocated by the plant to other parts.

Experiment VI

Studies on the effect of insecticides on the host (Green bug)—Parasite (Coccophagus bogoriensis KON) complex

In some preliminary studies on host parasite relationship, it was observed that *Coccophagus bogoriensis* is endoparasitic on Green bug adults. A decrease in the adult population of the host adversely affected the parasitic survival. In certain control trials with organophosphorus compounds and white oil emulsion, it was observed that there was an appreciable survival of adults in the case of the oil emulsion even at as high a concentration as 2.5 per cent. It therefore appeared that very low concentration of white oil emulsion may be ineffective against the adults while being lethal to the nymphs and therefore permit the survival of the parasite—endogenous in the adult bug, for effective biological control.

Exploratory trials were undertaken to test the selective effect of low concentrations of white oil emulsion, and to examine the possibilities of evolving a biological-cum-chemical control for Green bug. The experiment was started in April 1956.

White oil emulsion was prepared by emulsifying 150 parts of white oil with one part of Lissapol in water to give a 1 per cent emulsion and sprayed on Green bug infested plants. 2 plants were taken for each treatment. 4 leaves from each plant were taken and the population of the Green bug adults (healthy and parasitized) and nymphs were recorded, at short intervals for a period of 3 weeks and after 40 days from spraying. Observations were made on the toxic effect of the spray on:

Coffee plants,
Nymphs and adults of Green bug,
Immature stages of the parasite, and
Parasite emerging from the adult Green bug.
Persistence of toxicity was also observed.

No phytotoxic effect was noticed. The insecticide was toxic to nymphs but not to adult Green bugs. Immature stages of the parasite were not affected. Parasite emerging from the Green bug was not affected. Build up of the pest was noticed after 15 days from treatment. It would appear that the toxic effect of the insecticide lasted for a fortnight.

It was noticed that the parasite was active and maintained a high level of parasitization in both the white oil emulsion sprayed and control plants. But in the white oil emulsion treatment, there was considerable reduction in the population of nymphs whereas in Control there was a successive increase in the nymphal population. Observations recorded are given in Appendix XXXVII.

Studies on the control of shot-hole borer on robusta coffee: Xyleborus morstatti Hagdn

(a) Studies on the intensity and periodicity of shot-hole borer incidence

Studies on the incidence of the pest started in August 1954 were continued. Counts of the infested twigs were made at monthly intervals on 60 plants selected at random in an area of 10 acres. Five of such twigs per plant were split open to observe the developmental stages of the insect. The following table summarizes the data collected.

Month of observation	*Total Number of infested twigs in 60 plants*	*Month of observation*	*Total number of infested twigs in 60 plants*
July 1955	185	January 1956	286
August 1955	213	February 1956	137
September 1955	120	March 1956	116
October 1955	224	April 1956	57
November 1955	223	May 1956	15
December 1955	236	June 1956	—

The infestation was found to be increasing and was at a peak during January and thereafter there was a steady reduction. These observations are being continued to formulate necessary control measures against the pest.

(b) Trials with organic pesticides

Experiment I

The exploratory trial started in 1954 to find out the efficacy of insecticides for controlling shot-hole borer as compared to pruning was continued.

Two sprayings of the insecticides were given—one on the 17th August 1956 and another on the 19th September 1956. Corresponding to these sprayings, pruning of the infested twigs was done in the treatment under 'Pruning'. To

assess the efficacy of insecticides in protecting the plants from infestation under uniform conditions, all the infested twigs were removed before the imposition of treatments.

After the imposition of treatments, observations were made on the incidence of the pest at 20 days' intervals throughout the year. Two infested twigs from each plant were split open during each observation and the stages of the development of the insect noted. The results of observations are summarized in Appendix XXXVIII.

It would appear that in the treatments with G.1250 and B.H.C. 50 per cent W.P., the pest infestation was the lowest in September and October. The treatments with G.1250 and B.H.C. given in August and September appear to have been effective over a period of 60 days from the first application in giving protection to the plants from shot-hole borer attack.

Experiment II

An experiment was started in January 1956 to test the efficacy of Dieldrin compared with that of G.1250 and B.H.C. against shot-hole borer.

Following are the details:

Locality: Coffee Research Station, Balehonnur.
Layout: Randomized. Replications: 6. (2 plants under each.)
Treatments: 4.

A. B.H.C. 1 per cent
B. G. 1250 2 per cent
C. Dieldrin W.P. 0.125 per cent.
D. Control.

The insecticides were sprayed on to the tender twigs on 10-1-1956 and repeated on 21-2-1956. Counts of shot hole borer infested twigs were taken before the imposition of treatments. Subsequent observations were made at 21 days intervals and fresh infestations of the pest noted. Infested twigs were not removed before imposing treatments to allow the beetles developing in these twigs to attack fresh ones.

The results of observations are summarized in the following table:

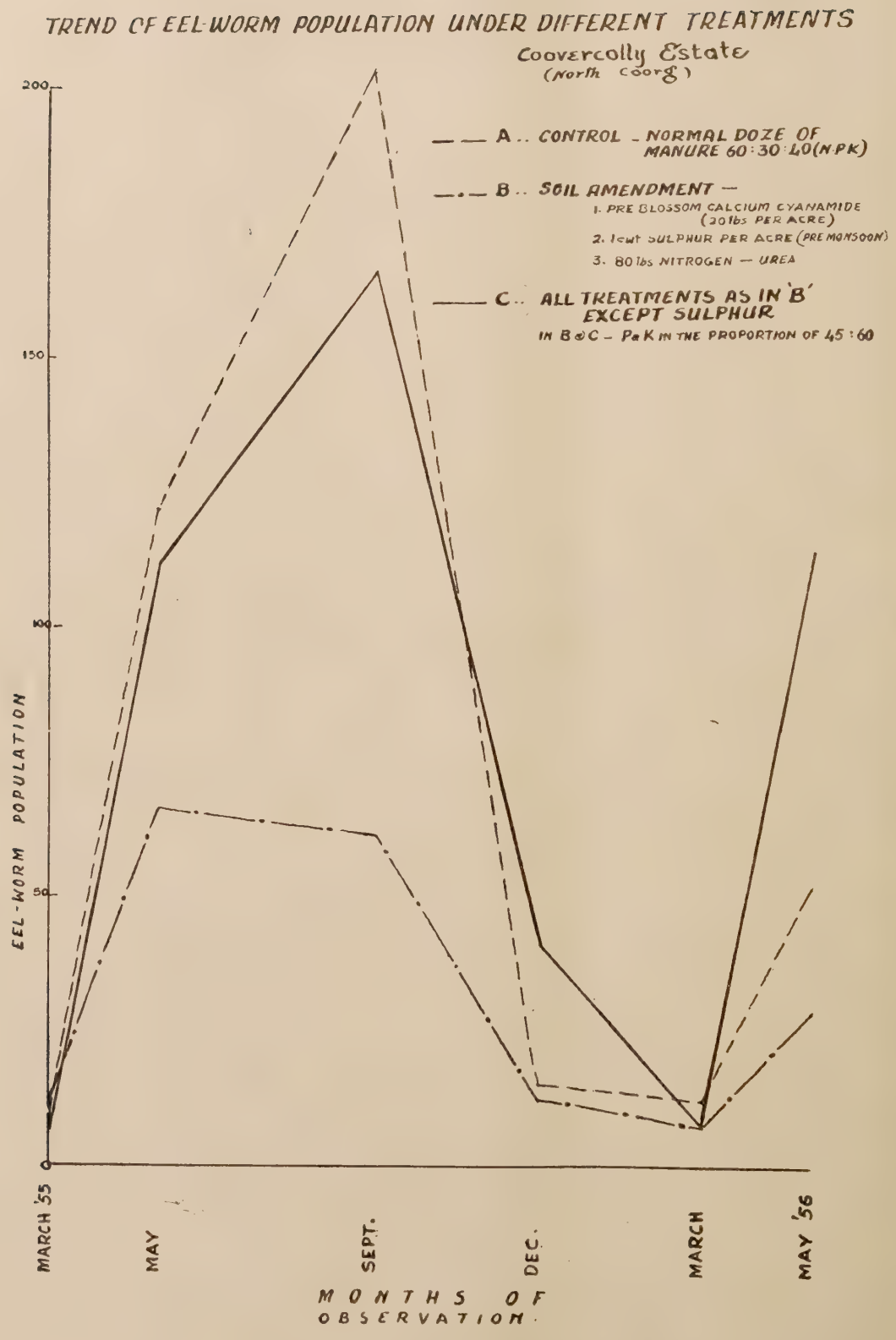
Treatments	*Initial infestation*	*Fresh Infestation*					
		1st Obsn.	*2nd. Obsn.*	*3rd. Obsn.*	*4th Obsn.*	*5th Obsn.*	*6th Obsn.*
A.	222	83	51	15	7	2	—
B.	289	73	60	18	7	3	—
C.	250	93	56	28	8	8	—
D.	291	150	94	46	19	7	—

It is seen that fresh infestation by shot-hole borer in G. 1250 treatment was far less than in others. The effects of treatments with B.H.C. and Dieldrin are next in order.

(c) Trials with systemic insecticides

In the trials for controlling Green bug, Systox and Metasystox applied by employing the 'binding method' were found effective. In the light of these interesting results, these two insecticides were used in exploratory trials to find out the persistance of their toxicity and arrive at effective concentrations for controlling shot-hole borer.

Trials were started in June 1956 in which each of these insecticides was applied by the 'binding method' (in a similar manner as for Green bug control) to young plants in pots and mature plants in the field. On potted plants, con-


TREND OF EEL-WORM POPULATION UNDER DIFFERENT TREATMENTS
Coovercolly Estate
(North Coorg)
A .. CONTROL - NORMAL DOZE OF MANURE 60:30:40 (N.P.K)
B .. SOIL AMENDMENT —
1. PRE BLOSSOM CALCIUM CYANAMIDE (20 lbs PER ACRE)
2. 1 cwt SULPHUR PER ACRE (PRE MONSOON)
3. 80 lbs NITROGEN — UREA
C .. ALL TREATMENTS AS IN 'B' EXCEPT SULPHUR
IN B & C - P & K IN THE PROPORTION OF 45 : 60
200
150
100
50
0
EEL-WORM POPULATION
MARCH '55
MAY
SEPT.
DEC.
MARCH
MAY '56
MONTHS OF OBSERVATION

centrations ranging from 1 to 2 per cent and on field plants 1.5 per cent and 3 per cent of each of the insecticides were used. In pot trials, 4 plants and in the field 2 big plants for each of the treatments were taken for trials.

Observations on shot-hole borer infestation on the treated field plants and releases of shot-hole borer on treated potted plants to find out the persistence of toxicity and efficacy of insecticides are in progress.

4. Studies on the control of soil pests

(1) Control of parasitic eelworms

In previous years, 1953-55, exploratory trials were made for the control of eelworms parasitic on coffee, by (1) using pesticides viz., nemacide (Shell D.D.), fumigant (Cynogas,) organophosphorus compounds-Ekatox, Folidol E.605, systemic insecticides Sytam, Hanane and B.F.P.O., and, (2) soil amendment treatments with lime, and calcium cyanamide + sulphur + urea. The relative efficacy of these treatments was assessed in trials on potted plants and in the field. Of these treatments, Ekatox was effective in arresting the increase of eelworms provided repeated applications were made, which would be uneconomical; the soil amendment with calcium cyanamide + sulphur + urea combination was effective in reducing the eelworm population.

The experiment started in 1955 in a private estate (Coovercolly estate, Coorg) to critically examine the possibilities of practical use of the soil amendment treatment on a field scale, was continued. Investigations were made on the relative importance of the use of calcium cyanamide and urea in combination with and without sulphur against eelworms.

Soil samples at depths of 0-9", 9-18", 18-27", and 27-36" were taken from each of the replications in March (before the imposition of treatments) and later in May, September and December 1955, and again in March and May 1956 after re-imposition of treatments, and were examined for eelworm population. The data are represented in a graph. (Graph No. 2)

It was noticed that the treatment, Calcium cyanamide and urea with sulphur was effective in arresting the increase of eelworms. The experiment is in progress.

We are grateful to Messrs Mangle Bros, and Messrs. Kothari and Sons for providing facilities to conduct these trials at Coovercolly estate, North Coorg.

(2) Use of Aldrinized fertilizer mixture for the control of soil pests

Aldrin (a chlorinated cyclopentadiene derivative) has been reported to be a soil insecticide having a long residual action and possessing high toxic effect against a wide range of soil pests. It is said that no taint or off-flavour is caused to crops grown in Aldrin-treated soil. Aldrin is also stated to be compatible with the common fertilizers and therefore could be mixed with the fertilizers and applied to the soil in the form of aldrinized fertilizer mixture. Since the two operations (application of aldrin and fertilizer) are combined in one application, the use of Aldrinized fertilizer mixture saves time and labour. Exploratory trials were started in 1955 to find out the efficacy of Aldrin used in the form of Aldrinized fertilizer mixture in the control of soil borne insects in collaboration with the Chemistry Section (vide p. 46 under Chemistry para A. (ii) (g).

Soil samples to a depth of 9 inches were taken from each sub-plot and examined for the different types of insects and their populations noted. Such observations were made prior to and after a month at each application of Aldrinized fertilizer mixture.

The experiment is in progress.

B. LABORATORY STUDIES

Studies on the possible parasites and predators on common pests of coffee

(a) Aspergillus tamari Kita

Host: Coffeee Stem Borer (*Xylotrechus quadripes Chev.*)

In previous years, *Aspergillus tamari* Kita, a fungus found on a beetle in coffee stem was tested to determine its pathogenecity on live beetles. Indications were that the fungus killed the beetles. The trials were extended for tests under field conditions. Spores of this fungus, suspended in nutrient medium were sprayed on to the borer infested stems in October—December 1955 and April—May 1956 flight seasons. After an interval of 25 days from treatments, the stems were split open and examined to observe fungal infection on the insects. In April—May 1956 trials, infection was not noticed on the insects in the Aspergillus treated stems whereas fungal infection was noticed on pupae in October—December trials. The observations are summarised below:

October-December 1955 Trials

Trial No.	*Treatments*	*Total Number of stems*	*Larvae*		*Pupae*		*Beetles*	
			Healthy	*Affected*	*Healty*	*Affected*	*Healthy*	*Affected*
1.	Aspergillus sprayed	5	6	—	2	4	—	—
	Control	5	4	—	2	—	2	—
2.	Aspergillus sprayed	5	2	—	2	2	—	—
	Control	5	4	—	1	—	2	—
3.	Aspergillus sprayed	10	6	—	—	—	1	2
	Control	10	4	—	4	—	4	—

It was noticed that out of a total of 27 (Larvae-14, Pupae-10 andBeetles-3) insects found in the Aspergillus treated stems, 6 pupae and 2 beetles were affected by Aspergillus whereas in the control the pupae and bettles did not show fungal infection. The larvae were not affected by the fungus in all the cases.

(b) Life history of Coccophagus bogoriensis KON

Host: Green bug (*Lecanium viride* G.)

Life history of *Coccophagus bogoriensis* KON was studied in March 1956. In this preliminary study it was observed that the parasite.

completed its life cycle in	18 to 22 days,
the larval stage lasted for	10 to 14 days,
prepupal stage	2 days and
pupal stage	6 days.

Egg stage appears to be of a very short duration. Determination of the period of incubation and the life cycle during winter are being taken up.

(c) Effect of parasitism on the reproduction of host

Parasite: *Coccophagus bogoriensis* KON.
Host: Green bug.

A few adult Green bugs were dissected for observation on the parasitic maggots of *Coccophagus bogoriensis* KON. Incidentally, a few eggs and nymphs of the host due for extrusion were noticed side by side with the parasitic maggot in the body of the host. This initiated the study of the effect of parasitism on the host. As a preliminary study parasites were released on

the adult Green bug and the production of nymphs from the parasitized host was noted daily for a period of 10 days from parasitization. The indications were that the bugs reproduced for 3-4 days from parasitization.

(d) Fungal parasites on Green bug

Attempts were made to raise the entomogenous fungii, *Empusa lecanii* and *Cephalosporium lecanii* on artificial medium. *Cephalosporium* was successfully cultured but *Empusa lecanii* failed to grow on the artificial media so far used. Further attempts are being made to find out a suitable medium to culture *Empusa lecanii*. The work is in progress.

Experiments at the Coffee Research sub-Station, Chethalli (Coorg)

1. Experiments on the use of insecticides for control of Coffee stem borer (Xylotrechus quadripes Chev.)

(a) The exploratory trial on the comparative efficiency of B.H.C. formulations for controlling borer started early in May 1953 was continued. Treatment with Folidol was discontinued due to practical difficulties in applying this poisonous material.

The observations recorded are summarized below:

Treatments	*Number of plants at the commencement of* 1955-56	*Total bored plants removed during* 1955-56	*Percentage*	
			Infested	*Good trees*
A. Chlordane	706	14	1.98	98.02
B. B.H.C.	680	7	1.03	98.97
C. Control	550	38	6.91	93.09
D. Toxaphene	707	5	0.71	99.29

The treatments do not show any significant difference among themselves, but all the treatments are significantly superior to Control.

(b) Trials with Dieldrin against B.H.C. formulations

This experiment started in November 1953 was continued. Following are the observations recorded:

Treatments	*No. of plants at the commencement of* 1955-56	*Total bored trees removed during* 1955-56	*Percentage*	
			Infested	*Good trees*
A. B.H.C. at 1 % ac. 4 times a year	886	4	0.45	99.55
B. B.H.C. at 1 % ac. 2 times a year	737	15	2.04	97.96
C. Control	777	30	3.86	96.14
D. Dieldrin 0.125 per cent 2 times a year	782	8	1.02	98.98

Application of B.H.C. four times a year has given the highest protection followed by Dieldrin 2 times and B.H.C. twice a year. All treatments are significantly superior to Control.

(c) Trials with B.H.C. formulations, organophosphorus compounds and Dieldrin started in April 1955 were continued.

(d) Trials with systemic insecticides

A few of the systemic insecticides were tried against Coffee stem borer on plants in situ, and the treated plants were cut open and examined two months after the treatment. The details of the treatments are as follows:

1. Sytam—5 c.c. in a gallon water—Sprayed on foliage.
2. Systox—7.5 c.c. in 1 gallon water—Irrigated.

3. Hanane—2 capsules a plant—inserted in contact with the tap root after scraping.

Each of the insecticides was tried on five plants (borer infested plants) in situ. The treated plants were split open after two months to observe the effect of the insecticides on the pest. At this stage, the insecticides did not seem to have any effect.

2. Control of eelworm

The experiment started during March 1955 to test the influence of the soil amendment treatment in minimising the ravages of the nematodes, as described in para IV (1) above, was continued.

S. A. Raja Rao
Entomologist

V. MYCOLOGY

Studies on the life history and control of the major diseases affecting coffee namely, leaf disease caused by *Hemileia vastatrix* (B and Br.), black rot caused by *Pellicularia koleroga* (Cke.) and nursery diseases like 'collar rot' and 'damping off' due to *Rhizoctonia solani* and brown-eye-spot disease due to *Cercospora coffeicola* were attempted. Field trials on spraying of coffee to find out efficient and economic methods of control of diseases and to evaluate the efficacy of various proprietary fungicides as compared with the present standard ½ per cent Bordeaux mixture in controlling the major diseases of coffee and fundamental work on the life history and possibilities of control of the common diseases of coffee were continued. Two new trials were started during the premonsoon period in 1956 to test some new proprietary fungicides for control of leaf disease. A series of tests were also undertaken with 'Low volume' spray equipment to find out if an economy in spray mixture could be effected using such equipment without impairing efficacy of disease control. Routine examination of diseased coffee specimens received from various private estates were also undertaken, the causative agents identified and remedial measures suggested as part of the advisory work of the section. A general preliminary survey of the incidence, periodicity and seasonal intensity of the diseases at the Research Stations and the several coffee zones was started with the active co-operation of the Liaison staff and the ready and active response of the planting community with a view to introduce and regularize effective control programmes.

Field Trials

A. Spray trials against leaf disease caused by Hemileia vastatrix

1. Spray experiment to compare the efficacy of different strengths of Bordeaux mixture

This experiment started in June 1951 to find out if spraying with Bordeaux mixture at strengths lower than the strndard ½ per cent could give efficient control of coffee leaf disease is being continued. Post and pre-monsoon spray applications with the different treatments (as described in the previous reports) were given in September 1955 and May 1956. Leaf counts were taken in September 1955 and February 1956. Crop yields for 1955 were also recorded.

The details of yield and leaf counts are summarised in Appendix XXXIX.

Yield records for 1955-56 and leaf counts during September 1955 and February 1956 show that there is no significant difference between the three

different strengths of Bordeaux mixture tried; however it is seen that both in yields and in the leaf counts, 0.5 per cent strength has given numerically better results than 0.375 per cent and 0.25 per cent strengths. It may be mentioned that in the previous year also 0.5 per cent strength gave numerically higher yields than the other two strengths. In February 1955 leaf counts, 0.5 per cent strength gave significantly superior results over 0.25 per cent strength.

2. Experiment to find out the efficacy of adding Detergents, Wetters, Spreaders and Adhesives to Bordeaux mixture

The experiment started in May 1954 to compare the efficacy of adding detergents, adhesives, spreaders and wetters to Bordeaux mixture as against plain Bordeaux mixture was continued. Post and pre-monsoon spray applications were given in September 1955 and May 1956.

Treatment E (Arkotine) could not be applied as the material was not available and this treatment was discontinued from 1955 post-monsoon spray.

The details of yield and leaf counts are summarised in Appendix XL. No significant differences were noticed between the different treatments in yield; however, plain Bordeaux mixture is better than Bordeaux mixture + Lissapol N numerically. No significant or numerical differences were noticed in the effective percentage of leaf retention.

3. Comparative trials using Bordeaux mixture and proprietary copper fungicides

(a) Experiment to compare the efficacy of proprietary copper fungicides with that of Bordeaux mixture

The experiment started in May 1953 to find out the efficacy of some of the copper fungicides—Wetcol 15, Fungi-copper-Geigy,and Cupravit—in controlling leaf disease as compared with standard Bordeaux mixture was continued. Post and pre-monsoon spray applications were given in September 1955 and May 1956.

The details of yield and leaf counts taken in September 1955 and February 1956 are summarised in Appendix XLI.

No significant differences between the four treatments were noticed either in yield or leaf counts.

(b) Experiment to compare the efficacy of proprietary fungicides with Bordeaux

The experiment started in September 1954 to find out the efficacy of Perenox, Blitox, Shell-Copper-fungicide, Parry's bye-product and Dithane Z-78 in controlling leaf disease as compared with Bordeaux mixture was continued. Post and pre-monsoon spray applications were given in Sept. 1955 and May 1956. Leaf counts were taken in Sept 1955 and February 1956. Treatment E (Parry's bye-product) was discontinued from September 1955 as the product was not available.

The details of yield and counts of Effective percentage of leaf retention are given in Appendix XLII.

Bordeaux mixture and Perenox have given significantly superior yields over Dithane Z-78.

In Sept 1955 leaf counts, Treatments D (Shell Copper fungicide), A (Bordeaux mixture), F (Dithane Z-78) and C (Blitox) are superior to Treatment B (Perenox) while in February 1955 leaf counts Bordeaux mixture alone was superior to Perenox. In February 1956 leaf counts no significant differences were noticed.

(c) Experiment to compare the efficacy of Blitox Ipsilion with Bordeaux mixture

An experiment to find out the efficacy of Blitox Ipsilion(12 per cent Copper Oxychloride Wettable Powder—Fisons Pest Control Ltd.) compared with Bordeuax mixture was started in the pre-monsoon period of 1956. Blitox Ipsilion is being tried at varying strengths and volumes as against $\frac{1}{2}$ per cent Bordeaux mixture at standard volume.

The first treatments were applied during June 1956. Following are the details of the experiment—

Locality: Crawford area—Coffee Research Station, Balehonnur.

Year of starting: 1956.

Treatments: 8.

A. Blitox Ipsilion 5 lb. in 300 galls per acre
B. ,, 10 lb. ,,
C. ,, 15 lb. ,,
D. ,, 5 lb. in 400 galls per acre
E. ,, 10 lb. ,,
F. ,, 15 lb. ,,
G. Bordeaux mixture 2-2-40 at 400 galls per acre.
H. Control No spray.

Replications: 5 *Layout:* Randomized

The details of the initial leaf counts taken in June 1956 prior to imposing treatments are given below:

Treatments	*Mean effective percentage of leaf survival*
A.	89.90
B.	85.50
C.	85.65
D.	84.25
E.	84.10
F.	88.85
G.	86.35
H.	86.65

4. Comparative trials using Bordeaux mixture and other fungicides

(a) Experiment to compare Mercurized Copper Oxychloride with Bordeaux mixture

This experiment started in September 1954 to find out the efficacy of Mercurized copperoxychloride as compared with Bordeaux mixture for the control of leaf disease was continued. Post and pre-monsoon spray applications were given in Sept. 1955 and June 1956.

The details of the counts of effective percentage of leaf retention taken in September 1955 and February 1956 are given in Appendix XLIII.

No significant differences are seen between treatments. Treatments A (Bordeaux mixture) and F (Copper Sandoz53) were numerically inferior to all the treatments with Mercurized copper oxychloride in the Sept 1955 leaf counts; however, during the following post-monsoon season when leaf disease incidence was severe, there was comparatively more defoliatition in plots treated with the latter. In February 1956 leaf counts Bordeaux mixture and Copper sandoz were found to have retained more leaves than most of the strengths of Mercurized Copper Oxychloride.

(b) Experiment to compare Tuzet fungicide (organic fungicide) with Bordeaux mixture

The exploratory trial started in May 1955 was continued. Post and pre-monsoon spray applications were given in September 1955 and May 1956. Leaf counts were taken during February 1956. The percentage of diseased leaves under the different treatments are given below:

Treatments	*Mean percentage of diseased leaves*
Bordeaux mixture 2-2-40	30.11
Tuzet fungicide 0.2 per cent	45.09
,, 0.1 per cent	41.26
,, 0.05 per cent	45.80

Infection is found to be less in Bordeaux treated plots.

(c) Experiment to compare the efficacy of proprietary fungicides with Bordeaux mixture

A trial has been started during the pre-monsoon season of 1956 to find out the efficacy of certain new fungicides in controlling leaf disease of coffee. Spray applications with the different fungicides were done in June 1956.

The details of the experiment are given below:

Locality: 'L-l' block, Coffee Research Station, Balehonnur.
Year of starting: 1956.
Treatments: 10.

A. Cuprokylt-1 lb. in 40 gallons of water.
B. M.C.M. copper oxychloride-1 lb. in 40 galls, of water.
C. Colloidal copper—1 lb. in 40 galls. of water.
D. Captan-2 lb. in 100 galls. of water + Ortho sticker—2.oz.
E. Captan-4 lb. in 100 galls. of water + Ortho sticker 2.oz.
F. Ultrasulphur-1 lb. in 60 galls. of water.
G. Bordeaux mixture-2:2:40.
H. ,, ,, + Tenac sticker at 1 oz. in 40 galls.
I. ,, ,, + Ortho sticker at 2 oz. in 100 galls.
J. Control—No spray.

Replications: 5. *Layout:* Randomized.

The details of initial leaf counts taken in June 1956 are given below:

Treatments	*Mean effective percentage of leaf survival*	Treatments	*Mean effective percentage of leaf survival*
A.	72.35	F.	73.40
B.	75.35	G.	72.85
C.	71.55	H.	74.95
D.	76.45	I.	73.90
E.	71.80	J.	71.40

It would appear from results obtained so far that the proprietary fungicides have not been superior, either in economics or efficacy of disease control, to freshly prepared ½ per cent Bordeaux mixture commonly used.

5. Low Volume spray trials

Scarcity of water at critical periods of requirement is often a limiting factor in efficient control of leaf disease in coffee by fungicidal sprays. Of late, low-volume sprayers are coming into popularity in many agricultural and orchard crops on account of the considerably smaller requirements of spray mixtures.

Preliminary and exploratory trials were started to compare low-volume (low pressure) spraying with the common high-volume (high-pressure) spraying.

(a) During 1955 pre- and post-monsoon periods, low-volume nozzles—Tee Jet 65006 and Vermorel—were compared with the standard Brodway Mistifier nozzle (High-volume high-pressure). The low-volume nozzles no doubt effected some ecomony in spray mixture, but the time consumed to give a proper under-surface spray coverage was much more compared to the high-volume high-pressure nozzles. It was also noticed that the low lifting force of the low-volume spray resulted in poor penetration and coverage. Counts of effective percentage of leaf survival taken in February 1956 are given below. Low-volume sprayed plots have recorded a lower effective percentage of leaf survival than the high-volume high-pressure sprayed plot.

Treatments	*Effective percentage of leaf survival-Feb.* 1956
Broadway Mistifier nozzle (High-volume High-pressure)	41.95.
Vermorel Low Volume nozzle	36.30.
Tee Jet No. 65006	40.40.

(b) In 1956 pre-monsoon season, a number of Low-volume nozzles of Birchmeyer make—Horto Saphire and Duro nozzles of different jet sizes—were compared with standard high-volume high-pressure nozzle—Peccallo nozzle 'O' jet. Some of the low-volume nozzles—Horto saphire nozzle 0.55 and 0.7 mm. jets—effected about 24 per cent saving in spray mixture but the time consumed was nearly double that of the high volume nozzle.

(c) In another set of trials, low-volume nozzles—Planta nozzle 'O' and 'I' jets—were compared with high-volume nozzles. Planta No. 'O' gave about 27 per cent saving in mixture in about the same time as required by high-volume nozzles. These Planta nozzles are proposed to be tested on a large scale during the post-monsoon period.

(d) Use of low-volume low-pressure spraying using a Knapsack Sprayer was also found to be not satisfactory in mature coffee; however, in young coffee, where the leaf area to be sprayed is comparatively less, there seems to be some promise of its adoption.

It was observed from these series of trials that, to get a proper under-surface leaf coverage on a dense bushy plant like coffee, a high-pressure was essential to provide proper lifting force and thereby help in good penetration. The low-volume spray equipment so far tested was found to have very poor lifting force as compared with the standard high-volume high-pressure spray equipment now in common use.

6. Relation of nutritional conditions to incidence of leaf disease

Studies were undertaken to find out whether differential nutritional conditions influenced the intensity of leaf disease incidence in coffee.

(a) Observations on the incidence of leaf disease were recorded in two adjacent blocks—one receiving a complete manure mixture and the other only nitrogenous manures for the past several years. These are given below:

	Mean percentage of diseased leaves		
TREATMENTS	*February* 1955	*September* 1955	*February* 1956
Complete manure mixture	32.90	34.30	20.40
Nitrogen only	33.80	40.50	23.70

It is seen that the plot receiving Nitrogen only has had a slightly higher disease incidence.

(b) Observations on similar lines were recorded in a Manurial Experimental Block where different combinations of N.P. and K are compared against an unmanured control. The results are summarised below:

	Mean percentage of diseased leaves		
Treatments	*July* 1955	*September* 1955	*February* 1956
N.P.K.	80.00	44.80	18.40
N.P.	79.20	44.80	21.00
N.K.	77.80	40.00	19.80
N.	72.90	44.40	19.70
No manure	83.10	42.30	21.00

It may be observed that in July 1955, the severity of incidence was in the order No manure, N.P.K., N.P., N.K. and N. In September 1955 it was in the order N.P.K., N.P., N, No manure and N.K.; and in February 1956, in the order N.P., No manure, N.K., N, and N.P.K. There appears to be no direct effect of nutritional conditions to Leaf disease incidence in these observations. However, it has been observed that an adequate balanced manuring helps the coffee plants to recover quickly from the effects of the disease as compared with unmanured or indifferently manured coffee.

B. Studies on Black rot due to Pellicularia koleroga (CKe)

1. Studies on the life history and mode of oversummering of Balck-rot fungus

These studies started during August 1954 in a block where black-rot is endemic were continued. Observations taken during the S.W. monsoon period of 1955 indicate the following:

(1) attempts at artificial infection by keeping infected material in contact with fresh healthy plants were successful when carried out towards the beginning or middle of favourable S.W. monsoon rains; but such attempts carried out towards the close of S.W. monsoon rains failed to infect even during the succeeding monsoon.

(2) Infected plants exhibit the disease early during the succeeding monsoon while surrounding plants not infected in the previous season continue to be free of disease. Even if affected leaves of infected plants are handled off, the disease appears on these plants early in the season following.

It would appear as though the fungus tides over the unfavourable dry months by remaining as resistant sclerotia or dormant mycelia lying protected in the crevices of the bark of live infected twigs which become active with the onset of South West monsoon rains in the following season.

2. Studies on the control of Black-rot

An observational trial to find out the efficacy of different fungicides in controlling black-rot with and without mechanical destruction of infected material was started at the Coffee Research Station, Balehonnur, during the S.W. monsoon period of 1955. The following treatments were tried on the infected plants during July 1955:

A. Bordeaux mixture 2-2-40	No handling
B. „ „	With handling.
C. No spray	With handling.

D.	Nospray	No handling.
E.	Bordeaux mixture 4-4-40	With handling.
F.	Mercurised copper oxychloride (4 lb. in 100 galls)	,,
G.	Tuzet fungicide (1 lb. in 100 galls.)	,,
H.	Dithane Z-78 (2½ lb. in 100 gallons,)	,,

Observations taken one month after treatment indicated the following:

Treatments combining a fungicidal spray with mechanical removal of diseased material gave the best control. There was very little fresh infection on plants treated with 1 per cent Bordeaux mixture, Mercurised copper oxychloride and Tuzet fungicide along with mechanical removal of infected tissues. Bordeaux ½ per cent was less effective than Bordeaux 1 per cent. Dithane Z-78 was less effective. Plants on which diseased material was not handled off and which received no fungicidal spray had the highest infection.

C. Nursery Diseases

1. Studies on damping off and collar-rot of nursery seedlings due to Rhizoctonia solani

General observations in the nursery indicated that in a good number of collar-rot infected seedlings, damage of the roots or the collar region by soil insects favoured entry of the fungal parasite causing collar-rot. Two phases of this disease were observed, viz., pre-emergence damping off occurring mostly in the primary germination beds, and collar-rot and post-emergence damping off, prevalent mostly after transplanting to baskets or secondary beds.

Attempts at control of these two phases of the disease were made by use of seed dressing materials, sterilization of soil in germination beds, secondary beds and in baskets prior to sowing seed or transplanting seedlings as well as soil drenching sprays with various fungicides applied after transplanting.

(a) Use of seed dressing materials to check seed decay and pre-emergence damping-off

The experiment using mercurial and non-mercurial seed dressing carried out in 1955 was repeated. Following are the observations recorded:

Treatments		*Percentage germination*	*Percentage damped-off*
A. Agrosan G.N.	2 oz. per 40 lb. of seed.	82.75	10.50
B. ,,	1 oz. ,,	81.00	10.00
C. T.B.4452-b	2 oz. ,,	80.50	12.50
D. Leytosan	2 oz. ,,	82.00	10.50
**E. Leytosol-B	1 in 150 (for soil sterilization)	83.25	5.00
F. Untreated (control)		78.50	9.25

**Soil sterilization with Leytosol B was found to delay germination in last year's trial. This treatment was, therefore, applied one week ahead of sowing.

Germination was highest in Leytosol-B treated beds following by Agrosan G.N. at 1 oz. per 40 lb. of seed.

Damping off was least in Leytosol—B treated beds and the highest in TB 4452-b treated plots.

The seed dressings in general appear to have helped in preventing seed decay and pre-emergence damping-off in the earlier stages but to be ineffective in preventing incidence of damping-off after a time. No bad effects on the

seedlings were noticed in any of the treatments as evidenced by the growth measurements data summarised below:

Treatments	*Average length of*		*Average Number of*
	Tap Root in inches	*Shoot in inches*	*Leteral Roots*
A.	3.00	2.18	27.20
B.	3.24	2.34	26.50
C.	2.41	2.34	24.30
D.	2.49	2.46	25.60
E.	2.45	2.13	26.70
F.	2.65	2.32	25.60

(b) Partial soil sterilization to check pre-emergence damping-off in germination beds

Following up the results indicated in the previous experiment, an exploratory trial was carried out in February 1956 to study the effect of sterilizing the soil with Formaldehyde in checking damping off in the germination beds.

Seeds were sown in beds sterilized with 0.8 per cent Formaldehyde three weeks earlier. Following are the observations recorded:

	45 days after sowing		**60 days after sowing**	
	percentage germination	*percentage damped off*	*percentage germination*	*percentage damped off*
Treated plots	75.50	Nil	80.50	1.24
Untreated plots	71.00	Nil	75.50	1.30

In both treated and un-treated beds, incidence of damping-off was negligible and there was very little difference in the percentage of seeds germinated.

(c) Control of post-emergence damping-off by using various fungicides

A trial to find out the efficacy of certain fungicides applied as a soil drench in controlling post-emergence damping-off was taken up in a nursery bed, where a high percentage of mortality due to the disease was noticed. The following four treatments were applied:

A. Bordeaux mixture ½ per cent.
B. Crag Industrial fungicide-974—100 lb. an acre.
C. Cheshunt's compound—1 lb. in 30 gall. water.
D. Untreated (control.)

Watering the bed was restricted in all the treatments as a general measure to reduce further infection. The details of the percentage of diseased seedlings taken three, six and ten days after imposing the treatments are recored below:

	Percentage damped-off		
Treatments	*After 3 days*	*After 6 days*	*After 10 days*
A.	1.70	Nil	Nil
B.	All seedlings wilted	All affected and removed	—
C.	2.70	1.80	Nil
D.	10.53	7.02	3.50

It is seen that ½ per cent Bordeaux mixture and Cheshunt's compound effectively checked further spread of the disease. A certain amount of check of the disease was obtained even in the untreated control plot by merely restricting watering the beds.

Crag fungicide was found toxic to the seedlings at the concentration tried. The tissue at the collar region developed a brownish, unhealthy and shrivelled look by the second day and the seedlings died on the 4th and 5th days.

(d) Comparative efficacy of various fungicides in controlling collar-rot and post-emergence damping off: Soil sterilization using fungicides

(i) The following eight treatments were applied as a soil drench to the baskets prior to transplanting of seedlings:

A. Iodine—1 in 5,000 dilution.
B. Formaldehyde—0.8 per cent strength.
C. Leytosol-B—1 in 150 dilution.
D. Bordeaux mixture—2-2-40.
E. Cheshunt's compound—1 lb. in 30 galls.
F. Ultrasulphur—1 lb. in 60 galls.
G. Crag fungicide 974—50 lb. per acre.
H. Untreated control.

Formalin was applied two weeks prior to transplanting, Crag fungicide and Leytosol-B one week prior and the other treatments two days prior to reduce chances of any toxicity to the seedlings. The seedlings were transplanted on the 14th May 1955. In one half of seedlings in all the treatments, a routine monthly ½ per cent Bordeaux spray was given in addition to the original soil sterilization.

On 14th June 1956, two seedlings in untreated control and one in Crag fungicide treated baskets had collar-rot, the others being free from disease. Observations taken again on 28th June 1956 showed that there was no further incidence of disease except on one seedling in Iodine treated baskets. During observations in July 1956, 2 damped off seedlings in Leytosol-B treated baskets were noticed. Further observations are continued.

(ii) The following nine treatments were applied as a soil drenching spray to seedlings in baskets one week after transplanting, to cover the collar region of the seedlings and to drench the surface soil to a depth of 3 to 4 inches.

A.	Bordeaux mixture	2:2:40
B.	Bordeaux mixture	4:4:40.
C.	Perenox	1 lb. in 40 gallons
D.	Blitox	,,
E.	Cheshunt's compound	1 lb. in 30 gallons.
F.	Dithane Z-78	10 oz. in 40 gallons.
G.	Iodine	1 in 20000 dilution.
H.	Captan	4 lb. in 100 gallons.
I.	Untreated (control).	

Treatments were repeated at monthly intervals starting from the last week of April 1956; four applications have been given so far.

Observations on disease incidence taken two weeks after each spray application are summarised below:

	Percentage damped off		
Treatments	*May* 1956	*June* 1956	*July* 1956
A.	Nil	3.13	3.13
B.	Nil	3.13	3.13
C.	3.13	6.25	6.25
D.	1.56	4.68	4.68
E.	Nil	1.56	3.13
F.	1.56	3.13	4.68
G.	6.25	10.90	10.90
H.	Nil	9.06	9.06
I.	1.56	10.90	12.50

It is observed that disease incidence has been the lowest in Cheshunt's compound and Bordeaux treated plants and the highest in Iodine treated and Control plants.

2. Studies on Brown-eye-spot disease caused by Cercospora coffeicola

This disease was of a very minor order in earlier years, but of late it has been on the increase in nurseries and new clearings. Studies were undertaken with the object of finding out differences if any in the relative susceptibility of different arabica coffee varieties to the incidence of Cercospora coffeicola, and also to assess the efficacy of certain fungicids on controlling the disease in nursery seedlings.

(a) Trial to assess relative susceptibility of different varieties of arabica coffee

Two sets of trials were conducted, one under artificially infected condition and the other under natural condition.

(i) Trials under artificial infection condition

Five seedlings in each of the four varieties of arabica coffee—Kents, Coorgs, S.795 and S. 288—were inoculated a week after transplanting to baskets with *Cercospora coffeicola* culture by keeping bits of the culture with moistened cotton on both the under and upper surfaces of the leaves. Observations taken at weekly intervals showed that none of the seedlings were infected even after one month. The trial was therefore repeated with a modification; a spore suspension in water prepared from naturally infected leaves was sprayed on 5 seedlings of each of the four varieties, having 2 paris of leaves including the primary ones. Observations taken two weeks after spray showed that one seedling of Kent and one of S.795 varieties were infected. After a month it was observed that all the 5 seedlings in all the varieties were infected. The data regarding the intensity of infection are summarised below:

		Number of leaves showing			
Variety	*Total No. of leaves on the 5 seedlings*	*No infection*	*Light infection*	*Heavy infection*	*Severely infected and fallen*
Kents	20	6	3	8	3
Coorgs	20	8	2	7	3
S. 795	20	7	2	8	2
S. 288	20	7	2	9	2

It may be observed that under artifical infection, all the four varieties are equally susceptible to the disease. It was noticed in most cases that primary leaves in all the varieties were lightly infected while infection was heavy in true leaves.

(ii) Trials under natural condition

Seedlings of the four arabica varieties—Kents, Coorgs, S.795 and S.288—were planted in secondary beds replicated six times in a randomised lay-out during June 1956. Observations on the relative incidence of the disease taken in July 1956 are recorded below—

		Number of seedlings showing	
Variety	*Total Number of seedlings*	*light infection*	*heavy infeciton*
Kents	36	2	8
Coorgs	36	3	5
S.795	36	2	8
S.288	36	3	4

No appreciable difference could be observed either in intensity of disease or the number of seedlings infected.

(b) Comparative efficacy of different fungicides in controlling Brown eye-spot disease in nursery seedlings

An experiment to find out the possibilities of control of this disease by use of fungicidal sprays was started with the following treatments on S.795 seedlings transplanted to beds in the first week of June 1956.

A. Control. No spray.
B. Bordeaux mixture 2-2-40.
C. -do- 4-4-40.
D. Dithane Z-78—10.0z. in 40 gallons.
E. Mercurised copper oxychloride—4 lb. in 100 gallons.
F. Captan—4 lb. in 100 gallons.

Replications: 4. Layout: randomized.

Spray applications were given once in a month starting from the third week of June 1956. Observations recorded during July 1956 are summarised below:

Treatments	*Total No. of seedlings*	Number of seedlings showing	
		Light infection	*Heavy infection*
A.	24	7	5
B.	24	7	4
C.	24	4	4
D.	24	4	3
E.	24	3	4
F.	24	6	4

Observations are continued.

Experiments at the Coffee Research sub-station, Chethalli:

1. Comparative trials with copper fungicides against Bordeaux mixture

The experiment started in 1953 to test the efficacy of Wetcol, Cupravit and Yellow Cuprocide as compared with the standard 2-2-40 Bordeaux mixture was continued. Following are the observations recorded:

Treatments	Effective percentage of leaf survival			YIELD Ripe cherry in lb.		YIELD Calculated clean coffee in cwt. per acre	
	Feb. 55	*Sept.* 55	*Feb.* 56	54-55	55-56	54-55	55-56
A. Wetcol	44.85	80.61	43.3	3264	2164	4.86	3.22
B. Bordeaux	51.93	86.83	53.4	4112	2346	6.12	3.24
C. Control	49.30	73.80	41.2	3312	2788	4.93	3.63
D. Cupravit	48.44	77.96	39.3	3024	1856	4.50	2.42
E. Yellow Cuprocide	47.93	86.65	55.1	3504	2055	5.21	3.05
Gen. Mean	48.49	81.17	46.46	3440	2242	5.12	3.11

2. Comparison of Mercurised Copper Oxychloride with Bordeaux Mixture

The experiment started in 1955 to test Mercurised copper oxychloride in leaf disease control was continued.

No significant differences have yet been observed.

K. V. George
Mycologist.

APPENDIX I

Meteorological data of the Coffee Research Station, Balehonnur 1955—56

		July 1955	Aug. 1955	Sept. 1955	Oct. 1955	Nov. 1955	Dec. 1955	Jan. 1956	Feb. 1956	Mar. 1956	Apr. 1956	May 1956	June 1956	July 1956
1.	Highest Maximum temperature ...	81.2	75.1	85.0	81.5	81.2	80.1	84.1	90.1	93.5	93.0	85.5	81.0	75.0
2.	Lowest Maximum temperature ...	69.4	68.5	71.0	73.0	75.0	74.5	77.1	79.5	87.5	84.5	79.5	78.0	67.0
3.	Highest Minimum temperature ...	67.0	65.8	67.5	67.6	65.0	64.2	62.5	64.0	67.8	69.5	68.8	67.5	65.6
4.	Lowest Minimum temperature ...	57.0	62.6	64.0	60.0	53.8	54.0	54.0	56.0	60.6	62.5	63.0	65.0	62.2
5.	Average Maximum temperature ...	73.9	72.1	78.0	78.4	78.6	78.0	80.6	84.0	90.1	88.6	81.8	79.4	70.0
6.	Average Minimum temperature ...	64.1	64.9	66.1	64.9	62.7	57.6	57.7	59.5	64.3	67.0	66.2	65.9	64.1
7.	Highest Humidity ...	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	98%
8.	Lowest Humidity ...	82%	90%	90%	71%	73%	67%	63%	41%	36%	74%	82%	90%	85%
9.	Average Humidity ...	95%	96%	92%	94%	85%	84%	86%	72%	88%	93%	91%	95%	96%
10.	Highest No. of hours of bright sunshine ...	10–12	9–06	8–48	8–48	10–18	9–42	10–00	10–48	9–24	10–42	10–36	4–12	8–12
11.	Lowest No. of hours of bright sunshine ...	0–00	0–00	0–00	0–25	3–00	7–00	7–30	8–12	7–00	0–12	0–12	0–00	0–00
12.	Average No. of hours of bright sunshine ...	2–54	1–45	4–18	4–42	7–54	8–43	9–30	9–24	8–42	9–00	6–00	2–24	0–42
13.	No. of days on which rainfall was below 10 cents ...	8	5	7	8	1	—	—	1	—	6	6	5	—
14.	No. of days on which rainfall was between 10-50 cents ...	14	16	14	13	2	—	—	1	2	4	6	17	8
15.	No. of days on which rainfall was between 50-100 cents ...	7	5	8	1	—	—	—	—	1	1	2	—	9
16.	No. of days on which rainfall was between 1″-2″	—	5	—	3	—	—	—	—	—	—	—	3	7
17.	No. of days on which rainfall was above 2″ ...	—	—	1	—	—	—	—	—	—	1	—	5	7
18.	No. of rainy days during the month ...	29	31	23	17	3	—	—	2	3	12	8	25	31
19.	Total rainfall during the month ...	9.52″	15.32″	13.76″	8.37″	0.60″	—	—	0.46″	1.12″	6.19″	3.33″	28.30″	37.61″
20.	Highest rainfall during the month ...	0.73	1.89	3.28	1.72	0.45	—	—	0.38	0.40	4.04	0.74	5.66	2.96

APPENDIX II

Rainfall data of the Coffee Research Station, Balehonnur
(Rainfall Recorded in Inches)

Month		1945/46	1946/47	1947/48	1948/49	1949/50	1950/51	1951/52	1952/53	1953/54	1954/55	Average of 10 years	1955/56
July	...	37.52	35.80	35.97	30.93	24.60	58.25	29.31	27.72	54.99	43.09	37.82	9.52
August	...	10.72	37.93	30.34	39.49	25.52	20.11	19.40	28.28	30.70	27.90	27.04	15.32
September	...	9.11	11.51	9.80	6.43	14.80	21.12	9.77	3.72	6.07	7.69	10.00	13.76
October	...	4.25	3.56	2.62	6.80	7.99	6.43	6.74	13.07	20.22	6.41	7.81	8.37
November	...	1.08	7.04	1.14	8.59	1.43	1.27	3.12	0.00	0.00	0.00	2.87	0.60
December	...	0.00	1.09	0.91	0.08	0.00	0.00	0.00	1.42	0.00	0.77	0.43	0.00
January	...	0.00	0.36	0.26	0.00	0.02	0.00	0.14	0.00	0.00	0.00	0.08	0.00
February	...	0.03	0.00	0.00	0.00	0.74	0.00	1.50	0.00	0.00	0.28	0.26	0.46
March	...	0.52	1.86	0.19	0.44	0.00	0.53	0.00	0.00	2.29	1.80	0.76	1.12
April	...	9.05	1.56	9.94	2.16	0.79	3.84	6.29	2.40	9.18	3.54	4.88	6.19
May	...	4.28	5.21	2.41	6.61	3.77	8.43	2.55	0.49	4.40	19.18	5.73	3.33
June	...	23.53	9.90	15.67	10.50	11.57	17.38	13.53	15.36	18.56	20.16	15.62	28.30
Total	...	100.09	115.82	109.25	112.03	91.23	137.36	92.35	92.46	146.41	130.82	113.30	86.97

Rainfall during July 1956 ... 37.61"

APPENDIX III

Rainfall Data at the Coffee Research Sub-Station, Chethalli

(Recorded in inches)

Month	1954/55	*Average for previous 15 years*	1955/56
July	25.66	23.08	5.25
August	12.13	12.56	5.82
September	4.08	5.69	5.69
October	7.68	7.02	10.75
November	0.00	2.79	0.75
December	1.39	0.73	0.00
January	0.00	0.12	0.50
February	0.00	0.25	0.03
March	0.46	0.88	0.18
April	5.61	3.73	4.92
May	11.69	5.31	2.93
June	13.04	10.65	18.67
Total	81.74	72.81	55.49

Rainfall during July 1956 ... 21.75″

APPENDIX IV

Trials in agronomy Practices

Locality: Balehonnur
Year: 1955/56
Plot size: Reps I, II and III
Repl. IV

Lay out: Randomized
Replications: 4
Variety: Coorgs Arabica
Gross: 18 × 8 = 144 plants or 8.37 cents
nett: 13 × 6 = 78 plants or 4.48 cents
Gross: 15 × 8 = 120 plants or 6.88 cents
nett: 13 × 6 = 78 plants or 4.88 cents

Total area under the experiment: 4.45 acres.
Treatments: (details on the reverse) 14

Symbol	*1951/52*		*1952/53*		*1953/54*		*1954/55*		*1955/56*	
	Ripe Cherry (per acre)	*Clean Coffee (per acre)*	*Ripe Cherry (per acre)*	*Clean Coffee (per acre)*	*Ripe Cherry (per acre)*	*Clean Coffee (per acre)*	*Ripe Cherry (per acre)*	*Clean Coffee (per acre)*	*Ripe Cherry (per acre)*	*Clean Coffee (per acre)*
A.	1774	2.72	649	0.88	4349	6.81	4783	7.94	2922	4.44
B.	2346	3.60	570	0.84	3574	5.86	5463	8.69	3339	5.04
C.	2128	3.27	486	0.76	4659	8.06	5733	9.48	4387	6.95
D.	1892	2.90	493	0.68	4699	7.57	4891	8.42	3554	5.36
E.	2082	3.20	510	0.76	4086	7.29	4487	7.44	3861	5.78
F.	1833	2.81	384	0.53	3724	6.66	5910	9.55	4030	5.36
G.	2323	3.57	358	0.55	4351	7.77	5172	8.39	3859	6.15
H.	2017	3.10	486	0.67	3791	6.51	5130	8.73	3107	4.68
I.	2300	3.53	460	0.69	4065	6.80	5529	9.25	4160	6.50
J.	2054	3.17	367	0.46	4386	7.33	6972	7.48	4099	5.60
K.	2092	3.21	298	0.49	3885	6.71	4802	7.91	3277	4.99
L.	1833	2.81	398	0.56	3403	6.08	4766	7.24	2537	3.99
M.	2200	3.38	500	0.60	4193	6.06	4709	7.86	3733	5.84
N.	2205	3.39	341	0.49	3790	6.47	5361	8.97	3678	5.54
Gen. Mean	2077.8	3.19	450	0.64	4068.2	6.86	5957.7	8.37	3610.2	5.44
Significant or not		No	Yes		No		Yes		No	
Critical Difference		1.18	122.4		158.2		508.25		1511	
St. Error % Mean		12.83	13.31		1.91		16.72		20.50	

Details of Treatments of Trials in Agronomy Practices

No.	Symbol	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Remarks:
1.	A	...	...	...	...	...	...	SW	DD	M Post-monsoon	SS	...	...	*Manuring:*
2.	B	...	M Pre-blossom		...	...	...	SW	DD	...	... SS	...	...	Unless otherwise stated,
3.	C	...	...	...	M Post-blossom		...	SW	DD	...	... SS	...	...	M. manuring @ 40:30:40 with
4.	D	...	...	...	...	...	...	SW	...	M KDAG	...	...	...	Urea, Rock phosphate and
5.	E	...	...	...	M		...	SW	...	M KDAG	...	...	...	Muriate of potash for N,
6.	F	...	...		...	...	...	CW	...	M CW	...	...	CW	P_2O_5 and K_2O respectively.
7.	G	...	...	...	M Pre-monsoon		...	CW	...	CW	...	...	CW	SS: Soil stirring SW: Slash
8.	H	...	SS M		...	...	...	CW	...	...	... ...	...	...	weeding DD: Deep digging
9.	I	...	...	...	M (20-30-40) Pre-monsoon		...	SW	...	M (20N only) KDAG	...	...	...	D(MF) Digging with mamootyfork
10.	J	...	PR		...	...	...	SW	DD	M	...	SS	...	ML: Mulching
11.	K	...	PR		...	...	...	SW	...	M KDAG	...	...	...	PR: Pruning
12.	L	...	M		...	...	...	...	...	...	... ...	...	D(MF) ML	KDAG: Kadagathe
13.	M	...	30M Am. Sulphate		...	...	...	...	...	30M Am. Sulphate	...	...	...	CW: Clean weeding.
14.	N	...	30M Sod. Nitrate		...	...	...	...	...	30M Sod. Nitrate	...	...	...	

APPENDIX V

Yield Data of the Soil Cultivation Experiment

Locality: Balehonnur *Variety:* Coorg Arabica about 30 years old.
Lay out: Randomized *Replications:* 4.
Plot Size: 4 × 20 = 80 plants or 4.5 cents.
Total area under experiment: 1.08 acres.

Symbol	Treatment	1954/1955 *Acre Yield* *Ripe Cherry*	1954/1955 *Acre Yield* *Clean Coffee*	1955/1956 *Acre Yield* *Ripe Cherry*	1955/1956 *Acre Yield* *Clean Coffee*
		lb.	*cwt.*	*lb.*	*cwt.*
A.	Trenching—1½′ × ¾′ × 5′ long—July	3204	5.26	4749	7.45
B.	Trenching—¾′ × ¾′ × 5′ long—July	4092	6.88	3030	4.39
C.	Renovation Pitting 1½′ × ¾′ × 3′ July	3673	5.99	3382	5.50
D.	Deep Digging—November	3872	6.11	3273	5.29
E.	Light Digging—November	3855	6.57	2798	4.28
F.	Control—Weeding only	3873	6.35	3147	4.89
	General mean	3761.5	6.19	3396.5	5.30
	Significant or not	Basic		No	
	Critical difference	701.25		1439	
	Std. Error percentage mean	34.98		19.88	

APPENDIX VI

Yield Data of the Soil management Experiment

Locality: Balehonnur *Variety:* Coorgs Arabica 30-40 years old.
Lay out: Randomized *Replications:* 4
Area under experiment: 1.26 acres.
Plot size: 5 × 16 = 80 plants or 4.5 cents.

Symbol	Treatment	*1954/55* *Acre Yield* *Ripe Cherry*	*1954/55* *Acre Yield* *Clean Coffee*	*1955/56* *Acre Yield* *Ripe Cherry*	*1955/56* *Acre Yield* *Clean Coffee*
		lb.	*cwt.*	*lb.*	*cwt.*
A.	Deep Digging—August	6698	10.61	5790	8.83
B.	Light Digging—August	6175	10.28	7054	9.14
C.	Deep Digging—November	4949	8.12	6373	9.78
D.	Light Digging—November	5842	9.78	7232	11.01
E.	Deep Digging—April	5543	9.10	6368	8.98
F.	Scuffling—April	4451	6.96	5573	8.66
G.	Control—weeding only	6151	9.91	5184	7.55
	General mean	5686.6	9.25	6224.9	9.14
	Significant or not:	Basic		No	
	Critical difference	643.75		2202	
	Std. Error percentage mean	21.55		16.84	

APPENDIX VII

Yield Data of Robusta Manurial Experiment, Coffee Research Station, Balehonnur.

Locality: Balehonnur *Variety:* Robusta
Layout: Randomized *Treatments:* 3 *Replications:* 6
Plot size: gross: 4 × 8 = 32 plants or 4.7 cents.
nett: 2 × 6 = 12 plants or 1.8 cents.
Total area under the experiment: 0.85 acre

Treatment	1951/52 Acre Yield		1952/53 Acre Yield		1953/54 Acre Yield		1954/55 Acre Yield		1955/56 Acre Yield	
	Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee
	lb.	cwt.	lb.	cwt.	lb.	cwt.	lb.	cwt.	lb.	cwt.
A. Manured @N-P-K = 40-30-40	1793	3.02	2427	5.07	3231	6.04	2494	3.95	4099	7.79
B. Manured @ N-P-K = 80-30-40	1804	3.27	2172	4.25	2710	5.87	2338	3.70	4932	9.19
C. Control— no manure	1331	2.44	2333	4.51	3231	5.38	2254	3.70	4826	8.17
Gen. Mean:	1624.7	2.91	2310.7	4.61	3057.3	5.76	2362	3.78	4619	8.38
Sign. or not		No	Yes		Yes		Yes		Yes	
Critical difference		1.70	221.0		1189.5		254.2		548	
Std. Error percentage mean		10.27	4.29		24.22		28.98		3.74	

APPENDIX VIII

Yield Data of Robusta Manurial and Pruning Experiment, Bhadra Estate, Balehonnur.

Locality: Bhadra Estate, Balehonnur. *Variety:* Robusta.
Layout: Latin Square. *Treatment:* 6. *Replications:* 6.
Plot size: gross: 6 × 10 = 60 plants = 8.8 cents.
net: 4 × 8 = 32 plants = 4.7 cents.
Total area under experiment: 3.17 acre.

Treatment	1952/53 Acre Yield		1953/54 Acre Yield		1954/55 Acre Yield		1955/56 Acre Yield	
	Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee
A. Control-no manure	3836	6.80	3417	5.50	4178	7.08	3340	5 68
B. Pruned only, no manure	3586	6.31	3346	5.29	3889	7.31	3657	5.88
C. Manured @ N-P-K = 40-30-40	3707	6.48	3705	5.95	3687	6.91	4739	8.89
D. Manure @ N-P-K = 80-30-40	4038	7.10	3623	5.38	4133	7.75	4232	7.55
E. N.P.K. = 40-30-40 + prune	4265	7.49	3664	5.60	5046	10.36	4623	9.09
F. N.P.K. = 80-30-40 + prune	3925	6.79	3665	6.18	4164	7.81	4677	8.78
General Mean	3892.5	6.81	3553.3	5.65	4182.8	7.87	4211.3	7.65
Significant or not	Yes		Yes		Yes		No	
Critical difference	624.7		267.8		378.3		1256	
Std. Error percentage mean	9.67		3.58		26.01		14.30	

APPENDIX IX

Yield Date of Robusta Manurial and Pruning Experiment Devadhanam Estate, Balehonnur.

Locality Devadhanam Estate, Balehonnur. *Variety:* Robusta
Layout: Latin Square *Treatments:* 6 *Replications:* 6
Plot size: gross: 6 × 10 = 60 plants = 8.8 cents
nett: 4 × 8 = 32 plants = 4.7 cents
Total area under the experiment: 3.17 acres.

Treatment	*1952/53 Acre yield*		*1953/54 Acre yield*		*1954/55 Acre yield*		*1955/56 Acre yield*	
	Ripe Cherry	*Clean Coffee*	*Ripe Cherry*	*Clean Coffee*	*Ripe Cherry*	*Clean Coffee*	*Ripe Cherry*	*Clean Coffee*
A. Control. No manure	5248	9.27	3097	4.29	3682	6.23	2975	4.78
B. Pruned only, no manure	5983	8.93	2812	4.52	4393	8.24	2604	4.23
C. Manured @ N-P-K = 40-30-40	5817	8.50	3472	5.57	3781	7.09	2546	4.78
D. Manured @ N-P-K = 80-30-40	5688	9.82	3466	5.16	4543	8.52	2894	5.17
E. N-P-K = 40-30-40 + prune	6545	11.52	3167	5.16	4156	8.53	3221	6.31
F. N-P-K- = 80-30-40 + prune	6040	10.79	3371	6.28	4699	8.81	3078	5.77
General Mean	5916.9	10.31	3230.8	5.16	4209	7.90	2886	5.21
Significant or not	Yes		Yes		Yes		No	
Critical difference	374.5		298.5		350.3		1023	
Std. error percentage mean	3.03		4.44		23.94		16.99	

APPENDIX X

Yield and Growth Measurement Data of Robusta Topping Experiment, Byregudda Estate, Balehonnur.

Locality: Byregudda Estate, Balehonnur *Variety:* Robusta
Layout: ABBA *Treatments:* 2 *Replications:* 12
Plot size: 8 × 4 = 32 plants = 5.95 cents.
Total area under the experiment: 1.43 acres.

Symbol	Treatment	*Average increase in length of branch*				*1955/56 Yield per acre Ripe Cherry in lb.*
		1952/53	*1953/54*	*1954/55*	*1955/56*	
		cm.	cm.	cm.	cm.	
A.	Topped at 3 ft. level	1.27	0.5258	0.1973	0.2326	469
B.	Topped at 4 ft. level	1.18	0.4168	0.1900	0.6425	668
General mean		1.28	0.4713	0.1936	0.4376	568.5
Significant or not		No	Yes	No	Yes	Yes
Std. Error percentage Mean			9.198	0.0077	7.09	3.243

APPENDIX XI (a)

Blossom-berry observation on station selections, 1955.

No.	*Arabica Station Selection*	Mean percentage of berry retention. *April*	*May*	*June*	*August*	*September*	*October*
1.	S.288	91.40	67.52	55.24	43.95	43.39	42.63
2.	S.333	97.50	90.13	75.35	69.36	69.36	62.64
3.	S.645	75.73	73.34	62.52	44.05	36.56	31.05
4.	S.795	71.88	82.41	62.91	55.15	45.01	43.89
5.	Kent	73.62	46.39	31.03	28.47	27.53	24.02
	Mean	82.03	71.96	57.41	48.20	44.36	40.85

APPENDIX XI (b)

Blossom berry observation on station selections, 1956.

Sl. No.	*Selection*	Mean percentage retention of berries. *April*	*May*	*June*	*July*
1.	S.288	76.73	64.84	50.65	42.34
2.	S.333	84.00	70.27	49.15	49.15
3.	S.645	93.11	88.90	79.51	42.69
4.	S.795	80.20	67.79	53.62	41.36
5.	Kent	78.06	76.51	53.01	53.01
	Mean	82.42	73.66	57.19	45.71

APPENDIX XII (a)

Studies in the germination of Arabica coffee seeds

Set—1: Seeds sown after drying in shade for a week
Date of sowing 5-1-1956

Symbol.	TREATMENT	Percentage germination as on *March*	*April*	*May*	*June*
A.	Seeds treated with ash, sown with parchment cover split	74.0	94.0	94.0	94.0
B.	„ „ removed	93.0	97.0	97.0	97.0
C.	„ „ intact	61.0	96.0	96.0	96.0
D.	„ not treated with ash, sown with parchment cover split	76.0	89.0	89.0	89.0
E.	„ „ removed	87.0	91.0	91.0	91.0
F.	„ „ intact	38.0	79.0	79.0	79.0
	General Mean	71.5	91.0	91.0	91.0

APPENDIX XII (b)

Set—II: A, B and C—Seeds sown at monthly intervals

Symbol	TREATMENTS	*Set II-A Sown on 2.2.56* Percentage germination as on *Mar.*	*April*	*May*	*June*	*Set II-B Sown on 5.3.56* Percentage germination as on *April*	*May*	*June*	*Set II-C. Sown on 5-4-56* Percentage germination as on *May*	*June*
G.	Seeds ashed+stored in tins+sown with parch. cover split ...	12.0	86.0	82.0	82.0	64.0	54.0	67.0	85.0	88.0
H	„ „ „ removed ...	50.0	83.0	74.0	68.0	57.0	52.0	54.0	86.0	88.0
I.	„ „ „ intact ...	12.0	82.0	83.0	83.0	71.0	79.0	51.0	80.0	95.0
J.	Seeds not ashed+ „ split ...	21.0	88.0	87.0	88.0	56.0	70.0	65.0	90.0	95.0
K.	„ „ „ removed ...	51.0	86.0	79.0	81.0	44.0	61.0	59.0	78.0	89.0
L.	„ „ „ intact ...	6.0	89.0	89.0	90.0	67.0	75.0	71.0	86.0	87.0
M.	„ „+stored in gunny+sown with parch. cover split ...	6.0	85.0	81.0	81.0	66.0	68.0	69.0	78.0	84.0
N.	„ „ „ removed ...	33.0	84.0	84.0	84.0	53.0	62.0	60.0	79.0	90.0
O.	„ „ „ intact ...	2.0	78.0	79.0	80.0	58.0	73.0	73.0	72.0	82.0
P.	Seeds ashed+stored in gunny+sown with parch. cover split ...	13.0	87.0	87.0	89.0	73.0	82.0	82.0	77.0	85.0
Q.	„ „ „ removed ...	33.0	84.0	88.0	88.0	43.0	53.0	49.0	86.0	78.0
R.	„ „ „ intact ...	12.0	82.0	81.0	83.0	77.0	83.0	82.0	64.0	89.0
	General Mean ...	20.91	84.5	91.17	83.1	60.75	67.67	65.17	80.92	87.5

APPENDIX XIII

Yield Data of Cultivation Experiment—Coffee Research Sub-Station, Chethalli

Started: 1953 *Layout:* 6 × 6 Latin Square
Locality: Chethalli (Coorg)
Variety: Arabica
Area of each plot: Gross — 16 × 10 plants
Nett — 14 × 10 plants

Treatments: A. Trenching 1½ ft. deep.
B. ,, ¾ ft. ,,
C. Renovation pitting.
D. Light digging.
E. Heavy digging.
F. Control—only removal of weeds.

Treatments	*Yield of ripe cherry per acre in lb.*		*Yield of clean coffee per acre in cwt.*	
	1954–1955	1955–1956	1954–1955	1955–1956
A	1733	1710	2.58	2.54
B	1538	1680	2.29	2.50
C	1763	1792	2.62	2.67
D	1358	1920	2.02	2.86
E	1613	1920	2.40	2.86
F	1920	1837	2.86	2.73
Mean	1650	1810		
Cr. Diff.	433.4	282.05		
S.E.M.	8.89	6.81		

APPENDIX XIV

Breeding of Arabica Coffee at Balehonnur (Mysore)

Method	*Purpose*	*Procedure adopted*
1. Hybridisation between two desirable parents	To secure best combination to produce vigour, resistance to leaf disease, and high yield.	1. *B.A.* 13 (Fl of S.31 × S.22:S.333) × *B.A.* 2 (Fl of S.26:S.288) 2. *B.A.* 21 (Fl of S. 178:S.583) × *B.A.* 14 (Fl of S.31 × S.22:S.333) and reciprocal. 3. *B.A.* 21 × *B.A.* 1 (Fl of S.26: S. 288) 4. *B.A.* 21 × *B.A.* 12 (Fl. of S.26 × Kents arabica: S. 327) and reciprocal 5. *B.A.* 14 × *B.A.* 27 (Fl of S. 44:S.353) and reciprocal 6. *B.A.* 12 × *B.A.* 34 (Fl of S.73:S.434) and reciprocal. 7. *B.A.* 34 × *B.A.* 1. 8. *B.A.* 27 × *B.A.* 12 9. 1404-70 (F3 of S.288 × Kents arabica) × 881 4/9 (Arabica collection from Anglo-Egyptian Sudan)
2. Selfing of desirable parents	For raising further progeny	1. S.947 4/1 (F3 of S.26) 2. S.947 4/4 (F3 of S26.) 3. S.947 2/11 (F3 of S.26). 4. S.881 2/8 (arabica collection from Anglo-Egyptian Sudan) 5. S.964 1/5 (F3 of S.288 × Maragogype) 6. S.964 2/10 (,, ,,) 7. S.885 19/10 (C. congensis × S.274 robusta)

APPENDIX XV

Comparative trials of clonal progeny

Locality: Balehonnur (Mysore)
Variety: Arabica hybrids
Replications: 8
Area of the experimental block 59.5 cents
Spacing 6′×6′
Layout: Randomized block
Plot: 3 plants in a row
Treatments: 20 cultures of the B.A. Series
Guard row: One on either side
Shade: Natural

Mean yield of three replications—Calculated yield of clean coffee in cwt. per acre

Culture	Yield		*Culture*	Yield	
	1954/55	1955/56		1954/55	1955/56
B.A. 5	0.60	1.49	B.A. 24	1.14	0.31
B.A. 6	1.05	1.68	B.A. 25	1.44	1.11
B.A. 11	2.25	2.84	B.A. 26	0.75	1.41
B.A. 12	5.22	3.35	B.A. 27	1.05	1.51
B.A. 13	2.79	1.19	B.A. 30	0.48	1.26
B.A. 19	5.76	2.21	B.A. 31	2.85	3.94
B.A. 20	3.15	1.51	B.A. 32	1.08	1.68
B.A. 21	0.96	1.08	B.A. 34	1.41	1.68
B.A. 22	2.43	2.39	B.A. 35	2.61	2.88
B.A. 23	3.45	2.26	B.A. 36	2.04	2.18

APPENDIX XVI

Comparative trials of clonal progeny

Locality: Balehonnur (Mysore)
Variety: Robusta
Treatments: 20 cultures of the B.R. Series.
Replications: 9
Spacing: 9 ft. by 9 ft..
Area of the experimental block: 96 cents.
Layout: Randomized block
Plot: 3 plants in a row
Guard row: One on either side
Shade: Natural shade.
Treatments: 10 cultures of the B.R. Series are: B.R. 2, B.R. 3, B.R. 5, B.R. 6, B.R. 7, B.R. 9, B.R. 11, B.R. 12, B.R. 15, B.R. 17.

Mean yield of five replicates: Calculated yield of clean coffee in cwts. per acre

B.R. 2	0.43	B.R. 6	2.88	B.R. 11	1.46	B.R. 17	1.40
B.R. 3	1.68	B.R. 7	1.39	B.R. 12	4.19		
B.R. 5	1.05	B.R. 9	1.80	B.R. 15	0.33		

APPENDIX XVII

Species, Varieties, forms and selections of Coffee obtained from foreign institutions and established on the Station since 1953

Species of Coffee other than Arabica

1. Coffea stenophylla	2. C. robusta	3. C. congensis
4. C. racemosa	5. C. lygustroides	6. C. canephora
7. C. salvatrix	8. C. kapakata	9. C. Dewevrei
10. C. robusta laurantii	11. C. liberica aruwimiensis	16. Kawisari-D
12. C. liberica arnoldiana	13. C. Dewevrei excelsa	
14. C. eugenoides	15. Kawisari-B	

Note: Items No. 6 and 14 show leaf disease.

Varieties, forms and selections of Arabica:

1. Bourbon amarelo
2. Bourbon vermelho
3. Catura amarelo
4. Laurina Maragogype
5. Mundo Novo
6. Typica
7. Bourbon
8. Pache
9. Local Bronze
10. Leroy (Laurina)
11. Sumatra
12. Jackson
13. Surinam
14. Blue Mountain Kenya
15. Blue Mountain
16. San Ramon
17. Philippinean
18. Gaudaloupe
19. Bourbon Mayagese
20. Pretoria
21. Columnaris
22. Kona
23. Padang
24. Murta
25. Mibirizi
26. Taffari Kela
27. S. 9 Arba Gougou
28. S. 12 Kaffa
29. Kabare
30. S. 16 Wollamo
31. S. 17 Yrgalem
32. S.2 B Ennerea
33. Salvador
34. Togokouma
35. Macenta
36. Colombie
37. Costa Rica
38. Gimma M'buni
39. Dalle (mixed green)
40. Dilla and Alghe
41. Dalle (Melville)
42. Rume Sudan
43. Mazeron
44. Reunion
45. Mysore
46. Java Foumban
47. Nkougam
48. Kenya
49. Kouti
50. Martinique
51. Antique
52. Tumbadir
53. Las Palmas
54. Green lipped
55. Peurto Rico
56. Gimma sidamo
57. Madagascar
58. Sudan Barbuk
59. Guinea Pita
60. Amphillo
61. Erecta
62. Geisha
63. K.P. 423
64. N. 205
65. H. 66
66. K.P. 162
67. K.P. 532
68. N. 39
69. N. 197
70. K. 7
71. Dilla (Melville)

Note: Item Nos. 1 to 56 and 63 to 71 have shown leaf disease in the field. Item Nos. 57 to 62 were planted during June 1956 in the field.

Varieties, and forms which have so far not shown leaf disease in the field

72. Cundinamarca
73. Macenta
74. Mokka
75. Wolkite
76. Java Noun
77. Nicaragua
78. Moka Blao
79. Darnam
80. Granza Blonay
81. Mibirizi D'mulungu
82. Local Bronze D'mulungu
83. Barbarina

Varieties, forms, and selections awaiting planting

84. Moka Dilla Sidamo
85. Limmu Gimma Kaffa
86. Harar Dugda Lemita Arussi
87. Harar Baca Harar
88. Badabuna Gimma Kaffa
89. Babaca Kaffa
90. Eniamba Kaffa
91. Misan Taffari Kela
92. Villalobus
93. Kents (Kenya)
94. Amphilla
95. Cera
96. Angustifolia
97. Anormalis
98. Xanthocarpa
99. Purpurescence
100. Semperflorence
101. Maragogype Vermelho
102. Polysperma
103. Goiba
104. Cumbaya
105. Cumbaya abnormal
106. H. 1
107. S. 16
108. A.C. 98
109. F. 502
110. A.C. 53

APPENDIX XVIII

Progressive increase in the supply of seed coffee of station selections from 1949

Year	*Arabica Selections*	*Kents Arabica*	*Robusta S.274*	*Robusta*	*Excelsa and Liberica*	*Total*
1949	150	262	62	759	2	1235
1950	253	173	47	506	—	979
1951	400	366	40	1046	1	1853
1952	695	80	45	1139	—	1959
1953	888	45	35	875	9	1852
1954	1456	20	106	720	31	2333
1955	5421	—	77	800	39	6337
1956	10669	—	189	1164	27	12049
Total	19932	946	601	7009	109	28597

Note: From observations at the station, it is noticed that 75 per cent seedlings of S.288, S.333, S.645, S.795 show resistance to races I and II of leaf disease, *Hemileia vastatrix B and Br.* that affect Coorgs and Kents arabica respectively. 25 per cent show susceptibility to these races. In the plots of these selections raised in the estates, the leaf disease susceptible plants have been noticed to occur upto 15 per cent.

APPENDIX XIX

Statement Showing the Yields of S.288 and S.795 in Some Private Estates

Estate and Date of Planting	Yield of S.288 and its progeny calculated in cwts. of clean coffee per acre at its														Date of Planting	Yield of S.795 calculated in Cwt. of clean coffee per acre at its						
	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th		3rd	4th	5th	6th	7th	8th	9th
	Year															Year						
Mysore State																						
Kuradykhan 1951	—	3.0	6.0																			
Bettadamane 1937 to 1951	0.59	0.78	2.3	3.6	3.1	3.9	6.5	7.7	6.5	N.A.	4.9	9.6	3.3	9.4								
Kummargod '50	N.A.	N.A.	5.2																			
Archullie* '50		1.3	3.2	4.8																		
Golgende	—	5.0	5.0	9.0	8.0																	
Burguai '39	—	—	—	Not	Available			—	—	—	5.0	7.0	6.0	10.0								
Daithapura '50*	4.4	4.4	13.3																			
Kogaravalli															1952	8.0						
Balur															1949	—	4.0	11.0	4.0	24.0		
Coorg State																						
Kibbetta 1949	0.2	1.2	2.2	6.5	8.7										1948 (a)	—	6.0	4.0	4.6	18.0		
															1949 (b)	0.38	2.8	5.1	13.5	17.3		
Santagherry '50		8.4	2.9	5.1																		
Pannia															1947	—	—	5.3	7.0	9.7	13.2	
Bisonfield '50	—	—	4.8	3.6																		
Madras State																						
Glenvans '50 (Nilgiri-Wynaad)	1.8	5.9	7.0												1950	0.8	2.8	3.8				
Cauvery peak (Shevaroys)															1951							
1951—1952	4.8	60													1952		3.3					

Note: 1. * III generation progeny of S.288 is being grown.
2. In quite a few cases the yield given is an approximation only.
3. For purpose of calculation 6 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.
4. N.A.=Not Available.

APPENDIX XX

Yield data of multiple stem vs. single stem system of growing coffee (Experiment I)

Locality: Balehonnur (Mysore) *Layout:* AB, BA Pattern. *Age of the plants:* 10 years from seed.
Variety: S.288, S.333, S.433, S.434 and Kents arabica (each variety having 12 rows of 16 plants in each row).
Spacing: 6 ft. by 6 ft. *Period of conversion to multiple stem:* May 1950. *Area of experimental block:* 95.2 cents.
Treatments: A. Single Stem; B. Multiple Stem. *Shade:* Natural shade.

Yield of ripe cherry (actual) in lb. and clean coffee in Cwt. calculated per acre (1,200 plants)

Year		A. Single Stem							B. Multiple Stem						
		*S.*288	*S.*333	*Kents*	*S.*433	*S.*434	*Kents*	*Mean*	*S.*288	*S.*333	*Kents*	*S.*433	*S.*434	*Kents*	*Mean*
1951:	*Year of conversion*														
1952:	Ripe Cherry ...	63	83	19	7	22	22	36	21	8	7	4	5	3	8
	Clean Coffee ...	1.17	1.52	0.35	0.13	0.42	0.41	0.66	0.38	0.15	0.13	0.07	0.09	0.06	0.15
1953:	Ripe Cherry ...	55	98	32	103	116	10	69	177	83	28	99	135	8	88
	Clean Coffee ...	1.02	1.82	0.60	1.92	2.16	0.18	1.28	3.28	1.53	0.52	1.83	2.52	0.15	1.64
1954:	Ripe Cherry ...	243	421	226	227	416	374	318	463	338	370	452	643	160	404
	Clean Coffee ...	4.52	7.83	4.20	4.22	7.74	6.96	5.91	8.6	6.28	6.88	8.41	11.96	2.98	7.52
1955:	Ripe Cherry ...	180	128	115	49	62	75	101	144	125	113	73	56	84	99
	Clean Coffee ...	3.34	2.38	2.13	0.91	1.15	1.39	1.88	2.68	2.32	2.12	1.36	1.04	1.56	1.85
1956:	Ripe Cherry ...	643	597	404	328	539	248	459.8	880	622	267	225	367	117	413
	Clean Coffee ...	11.96	11.14	7.51	6.10	10.03	4.61	8.56	16.37	12.46	4.97	4.19	6.82	2.18	7.86
Mean:	Ripe Cherry ...	236.8	265.4	159.2	142.8	231.0	145.8	196.8	337	235.2	157	170.6	241.2	274.4	202.9
	Clean Coffee ...	4.40	4.94	2.96	2.66	4.30	2.71	3.66	6.26	4.55	2.92	3.17	4.49	1.39	3.7

Note: 6 lb. of ripe cherry has been taken to yeild 1 lb. of clean coffee.

APPENDIX XXI

Yield Data of Multiple stem vs. Single Stem System of Growing Coffee (Experiment II)

Locality: Balehonnur (Mysore) *Layout:* Randomized block
Variety: Arabica hybrids *Plot:* 4 × 4 = 16 plants
Treatments: 4 during the year of conversion *Spacing:* 6′ × 6′
Replications: 4
Shade: Natural shade *Age of the plants:* 23 years from seed
Area of the experimental block: 105.8 cents.
Period of conversion: March 1951.

Treatments are:

A. Single stem.

B. Primary branches on one side were pruned off during March 1951 to encourage free growth of suckers for forming the multiple stems. After crop harvest during March 1952 the main stem was stumped to a height of 2 ft. from the ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

C. Extended centring upto one foot from the centre was done during the year of coversion (1951) to facilitate free growth of 3 suckers for forming the multiple stems. After the crop harvest during March 1952, the main stem was stumped to a height of 2 ft. from the ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

D. Except the two top primary branches all the other branches were cut down during the year of conversion (1951) to facilitate free growth of three suckers. After crop havrest during March 1952 the top-most primary branch was retained to act as a lung branch and the three suckers form the multiple stems.

Mean yield of ripe cherry per plot (actual) in lb. and calculated yield of clean coffee in cwt. per acre (1,200 plants)

Treatment	Ripe cherry (actual)					Clean coffee (calculated)				
	1952 conversion year	1953	1954	1955	1956	1952 conversion year	1953	1954	1955	1956
	lb.	*lb.*	*lb.*	*lb.*	*lb.*	*cwt.*	*cwt.*	*cwt.*	*cwt.*	*cwt.*
A.	38.63	47.14	208.46	100.44	190.83	1.08	1.31	5.81	2.80	5.32
B.	22.11	12.24	262.16	92.31	192.90	0.62	0.34	7.31	2.58	5.40
C.	24.62	26.11	272.46	110.06	251.00	0.68	0.73	7.66	3.07	7.00
D.	38.38	34.73	246.84	99.38	225.49	1.07	0.97	6.77	2.77	6.29

Note: 6 lb. ripe cherry has been taken to yield one lb. clean coffee.

(The growth of suckers for forming the multiple stems is observed to be the best in treatment B).

APPENDIX XXII

Yield data of multiple stem vs single stem system of growing coffee (Experiment III)

Locality: Balehonnur (Mysore).
Variety: Arabica hybrids.
Treatments: 2 A. Single stem.
B. Multiple stem.
Replications: 21.
Area of the experimental block: 52 cents.
Layout: AB, AB pattern.
Plot: 16 plants in a row.
Spacing: 6 ft. by 6 ft.
Age of the plants: 12 years from seed.
Shade: Natural shade.
Period of conversion: March 1951.

Mean yield of ripe cherry per plot (actual) in lb. and calculated yield of clean coffee in cwt. per acre (1200 plants)

Treatment	Ripe Cherry						Clean Coffee					
	1952*	1953	1954	1955	1956	Mean	1952*	1953	1954	1955	1956	Mean
A. Single Stem	5.78	19.43	24.72	18.99	11.94	18.77	0.64	2.17	2.76	2.12	0.44	1.87
B. Multiple Stem	3.90	8.03	21.49	15.20	24.82	17.39	0.44	0.89	2.40	1.69	0.92	1.48

Note: 6 lb. of ripe cherry has been taken to yield one lb. of clean coffee.
* Conversion year.

APPENDIX XXIII

Yield data of multiple stem vs single stem system of growing coffee

Locality: Balehonnur (Mysore).
Variety: Robusta
Treatments: 2. A. Single stem.
B. Multiple stem.
Replications: 2.
Layout: Opposite quadrants on a rectangular block are on each of the two treatments.
Spacing: 9 ft. by 9 ft.
Shade: Natural shade.
Area of the experimental block: 65.50 cents.
Age of the plants: 10 years from seed. *Period of conversion:* Sept. 1951.

Treatments	Ripe cherry per plot (actual)					Calculated yield of clean coffee per acre (538 plants)				
	1953	1954	1955	1956	Average	1953	1954	1955	1956	Average
	lb.	lb.	lb.	lb.	lb.	cwt.	cwt.	cwt.	cwt.	cwt.
A. Single Stem	121.06	110.30	138.00	312.0	172.84	1.33	1.20	1.51	2.93	1.74
B. Multiple Stem	52.69	153.63	105.34	213.5	131.29	0.58	1.61	1.15	1.51	1.21

Note: 5 lb ripe cherry has been taken to yield one lb. of clean coffee.

Yield data of arabica varietal trial plots at the Coffee Research sub-station, Chethalli

Locality: Chethalli. *Size of plot:* 12 × 8 = 96 plants.
Lay-out: Latin square. *Spacing:* 6½′ × 6½′ 9.32 cents.
Treatments: 4. *Planted:* 1949
S. 446, S. 795, S. 645 and S. 288. *Area under Expt.* 1.49 acres.

Particulars	Yield/acre Ripe cherry in lb. and Clean Coffee cwt. A S.446	B S.795	C S.645	D S.288	Mean	S.E.M. %	Sig. or not	Crit. diff.	Conclusion
1952									
Ripe Cherry	875	255	193	133	364	23.48	Yes	191	A B C D
Clean Coffee	1.30	0.38	0.29	0.20	0.54	—	—	0.43	
1953									
Ripe Cherry	3746	1897	1366	808	1954	16.22	Yes	1095	A B C D
Clean Coffee	5.57	2.82	2.03	1.20	2.91	—	—	1.63	
1954									
Ripe Cherry	1541	3402	2478	1498	2230	14.18	Yes	1096	B C A D
Clean coffee	2.29	5.06	3.69	2.23	3.32			1.63	
1955									
Ripe Cherry	6939	9043	4865	4404	6063		Yes		B A C D
Clean coffee	8.84	13.46	7.24	6.55	9.02				
1956									
Ripe Cherry	1997	8551	5821	4259	5157		Yes		B C D A
Clean coffee	3.00	12.70	8.60	6.30	7.65				

Studies on the essential requirements of plant foods N.P.K. for coffee in relation to improvement in yield—New manurial series
Yield Record and Percentage of Floats in the Harvest

Area of Experimental plot: 76 cents *Started in* 1937.
No. of plants per Sub-plot: 5×8=40 (Upto to January 1955)
No. of plants per Sub-plot: 5×4=20 (from January 1955). *Layout:* Latin square. *Treatments:* 5 *Replications:* 5.
Shade: Artificial, bamboo slats on pandal. *Spacing:* 5′×5′ (upto January 1955).
Guard Rows: One row all round the block. *Spacing:* Along the rows: 10′ Along diagonal: 7′
Annual Rate of Manuring: Nitrogen 60 lb. to the acre in three equal doses.
Phosphoric Acid 30 lb. acre in two equal doses.
Potash 40 lb. acre in two equal doses.

Year and Particulars	Average yield of ripe cherry in lb. and clean coffee in cwts. calculated to the acre. Percentage of floats in the harvest — TREATMENTS					Standard error as percentage of general mean	Critical difference P=0.05	Significant or not	Conclusions	
	N *A*	*NP* *B*	*NK* *C*	*NPK* *D*	*Control* *E*					
1955 Ripe Cherry	6672	7701	7040	7211	6398	25.66	1752	No	BDCAE	
1955 Clean Coffee	9.44	10.63	9.83	10.06	9.09	6.99	2.522	No		BDCAE
1956 (*a*) Cherry based on 20 plants	3391	4394	3191	3819	3121	7.70	850.127	Yes	BDACE	
1956 (*b*) Cherry based on 40 plants	6782	8788	6382	7637	6242	7.70	1700	Yes		BDACE
1956 (*a*) Clean coffee based on 20 plants	5.04	6.99	4.89	5.64	4.71	8.36	1.39	Yes	BDACE	
1956 (*b*) Clean coffee based on 40 plants	10.08	13.38	9.78	11.28	9.42	8.36	2.78	Yes		BDACE
Average ripe cherry for 16 years	1540	1805	1628	1746	1347	4.396	223.55	Yes	BDCAE	
Average clean coffee for 8 years	3.714	4.216	3.702	3.913	3.286	3.700	0.430	Yes		BDACE
1955 Floats by volume	5.55	7.35	6.47	7.28	5.59	6.78	1.35	Yes	BDCEA	
1955 Floats by weight	6.71	8.40	7.51	7.77	6.39	5.82	1.319	Yes		BDCAE
1956 Floats by volume	4.29	4.47	3.67	2.90	3.96	1.973	2.345	No	BAECD	
1956 Floats by weight	3.95	4.28	3.38	2.78	3.75	1.975	2.204	No		BAECD

APPENDIX XXVI

N.P.K. trials with varying levels of N.P.K. Fundamental manurial experiments in the pH cisterns

Yield record and percentage of floats in the harvest

Area of experimental plot: 0.5 cent. *Lay-out* Latin square *Treatments:* 6. *Replications:* 6.
No. of plants per sub-plot: One. *Spacing:* 7½". *Started in* 1950.
Shade: Artificial-coir matting over pandal.
Annual Rate of Manuring:

A	20 lb.	Nitrogen,	30 lb.	Phosphoric Acid,	40 lb.	Potash to the acre..		
B	30 ,,	,,	30 ,,	,,	40 ,,	,,		
C	45 ,,	,,	30 ,,	,,	40 ,,	,,		
D	30 ,,	,,	45 ,,	,,	40 ,,	,,		
E	30 ,,	,,	45 ,,	,,	60 ,,	,,		
F	45 ,,	,,	67.5	,,	90 ,,	,,		

Year and Particulars	Average yield of ripe cherry and clean coffee in lb. per plot and percentage of floats — TREATMENTS						Standard error as percentage of genl. mean.	Critical difference	Significant or not	Conclusions
	20:30:40 A	30:30:40 B	45:30:40 C	30:45:60 D	45:67.5:90 E	F				
1955 Ripe Cherry ...	2.08	1.91	1.34	0.99	1.46	1.61	21.09	0.94	Yes	A B F E C D
1955 Clean Coffee ...	0.32	0.30	0.21	0.15	0.18	0.25	2.01	0.14	Yes	A B F C E D
1956 Ripe Cherry ...	4.07	2.77	4.70	3.23	3.44	5.86	20.67	2.44	Yes	F C A E D B
1956 Clean Coffee ...	0.68	0.45	0.78	0.52	0.57	0.95	21.14	0.36	No	F C A E D B
Average ripe cherry for 3 years ...	2.53	1.83	2.27	1.64	1.82	2.96	18.82	1.21	No	F A C B E D
Average clean coffee for 3 years	0.41	0.30	0.37	0.27	0.30	0.48	21.62	0.20	No	F A C B E D
1955 % of floats by volume ...	18.51	20.49	15.40	23.14	16.99	14.28	13.14	7.04	Yes	D B A E C F
1955 % of floats by weight ...	21.33	23.54	18.52	29.22	19.99	17.55	12.37	7.91	Yes	D B A E C F
1956 % of floats by volume ...	19.63	17.97	22.67	22.63	22.87	19.55	10.65	6.57	No	E C D A F B
1956 % of floats by weight ...	18.03	18.73	20.26	21.53	21.21	18.26	10.56	6.13	No	D E C B F A

APPENDIX XXVII

Comparative trials on the influence of different forms of nitrogen on growth and yield of coffee—Experiments in rubber area
Yield Record

Area of experimental plots: 0.64 acre. *Layout:* Randomized block.
No. of plants per plot: Gross 4×16=64. *Nett:* 2×14=28. *Treatments:* 3. *Replications:* 4.
Annual rate of manuring: *Started in September* 1953: *Spacing:* 6.

A 60 lb. Nitrogen as Urea in 3 equal doses, 30 lb. Phosphoric acid, 40 lb. potash to the acre.
B 60 lb. Nitrogen as calcium Cyanamide, ,, ,, ,, ,,
C 60 lb. Nitrogen as Ammonium Sulphate Nitrate ,, ,, ,,

Year and Particulars	Yield of ripe in lb. calculated to the acre TREATMENTS A	B	C	Standard error as percentage of genl. mean.	Critical difference	Significant or not	Conclusions
1956 Ripe Cherry ...	3702	3949	3360	25.51	63.51	No	$\overline{\text{B A C}}$
Average ripe cherry for 3 years ...	4778	3589	2742	18.08	54.06	No	$\overline{\text{A B C}}$

APPENDIX XXVIII

Studies on the application of Nitrogen only in divided doses in relation to yield of coffee—Ossoor manurial experiments
Yield Record

Area of experimental plot: 0.8 acre. *Lay-out:* Randomized block. *Treatments:* 4. *Replication:* 6.
No. of plants per plot: 8×5=40. *Spacing:* 6′ started in June 1956
Shade: Natural mixed shade.
Annual rate of manuring: A 80 lb. Nitrogen only to the acre in one single dose.
B 80 ,, ,, in two equal doses of 40 lb. each.
C 80 ,, ,, in three doses: 30 lb., 20 lb. and 30 lb.
D Control—No treatment.

Year and Particulars	Average yield of ripe cherry in lbs calculated to the acre TREATMENTS				Standard error as percentage of genl. mean.	Critical difference	Significant or not	Conclusions
	A	B	C	D				
1955 Ripe Cherry ...	2090	2355	2065	2160	16.25	176.90	No	B D A C
1956 Ripe Cherry ...	3331	3229	3093	3207	8.64	25.08	No	A B D C
Average Ripe Cherry for 3 years ...	2522	2822	2594	2812	9.24	20.56	No	B D C A

APPENDIX XXIX

NURSERY MANURIAL TRIALS

Comparative trials using Rapid-gro and other nitrogenous fertilisers

Height of Seedlings and leaf population (average of 3 replications of seedlings each)

Treatments:—8 (1) A. Cowdung extract—6 baskets of cowdung strirred up in 40 gallons of water, left overnight and supernatant liquid used.
(2) B. Ammonium sulphate—11 lb. 2½ oz. in 22 gallons of water.
(3) C. Rapid-gro—1 lb. in 22 gallons of water.
(4) D. Control—No treatment.
(5) E. Urea—8 oz. in 22 gallons of water.
(6) F. Ammonium nitrate—11 ozs. in 22 gallons of water.
(7) G. Nitrophosphate 19% N_2 + 19% P_2O_5 — 1 lb. 3½ oz. in 22 gallons of water.
(8) H. Chilean nitrate—1 lb. in 22 gallons of water.

Plot: 12 beds of basket seedlings in the nursery containing 7,200 seedlings, divided into 24 plots, half a bed containing three units of 100 seedlings each used for each plot.

Replications: 3 Layout: Randomized block.

Height of seedlings	Treatments								standard error as % of gen. mean	Critical difference P = 0.01	Critical difference P = 0.05	Significant or not P = 0.01	Significant or not P = 0.05	Conclusions P = 0.01	Conclusions P = 0.05
	A	B	C	D	E	F	G	H							
Initial before application 24. 4. 55	2.02	2.14	2.23	2.07	2.31	2.07	2.07	2.28	7.34	0.038	0.277	No	No	HECBDFGA	HECBDFGA
After 4 applications 24.5. 55 ...	3.44	3.46	3.35	3.39	3.42	3.54	3.41	3.23	3.04	0.435	0.313	No	No	FBAEGDCH	FBAEGDCH
After 8 applications 24.6.55 ...	4.99	4.50	4.70	4.63	4.69	4.52	4.74	3.86	0.51	0.984	0.709	No	No	AGCEDFBH	AGCEDFBH
After 12 applications 24.7.55 ...	5.88	5.81	6.58	6.11	6.50	6.01	6,25	4.52	13.11	3.289	2.369	No	No	CEGDFABH	CEGDFABH
After 16 applications 24.8.55 ...	7.54	9.12	10.64	8.09	10.37	9.35	10.06	5.44	6.29	2.338	1.685	Yes	Yes	CEGFBDAH	CEGFBDAH
After 20 applications 24.9.55 ...	9.56	12.51	14.47	9.85	13.34	11.07	13.96	5.87	5.97	0.900	0.648	Yes	Yes	CGEBFDAH	CGEBFDAH

Leaf Population:

Initial before application 24.4.55	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1	2.421	0.2047	0.1475	No	No	HABCDEFG	HABCDEFG
After 4 applications 24.5.55 ...	5.3	4.5	4.5	4.7	4.4	4.5	4.9	5.1	0.6125	1.223	0.8810	No	Yes	AHGDBCFE	AHGDBCFE
After 8 applications 24.6.55 ...	7.7	7.7	7.6	7.5	7.5	7.1	7.8	7.0	3.675	1.156	0.8332	No	No	GABCDEFH	GABCDEFH
After 12 applications 24.7.55 ...	9.3	10.3	10·5	9.7	10.1	9.1	9.9	8.1	4.942	2.004	1.444	No	No	CBEGDAFH	CBEGDAFH
After 16 applications 24.8.55 ...	10.7	12.7	12.7	11.9	13.3	10.3	12.5	7.9	0.5412	2.623	1.89	Yes	Yes	ECBGDAFH	ECBGDAFH
After 20 applications 24.9.55 ...	12.7	12.3	15.2	13.6	15.1	12.5	14.9	5.7	5.07	2.729	1.965	Yes	Yes	CEGDAFBH	CEGDAFBH
Initiation of primaries** ...	0.33	9.67	18.00	2.67	10.33	6.33	14.33	0.0	46.34	15.05	10.59	Yes	Yes	CGEBFDAH	CGEBFDAH

** (Number of plants with primaries out of 300 in each sub-plot.) Average of 3 replications. After 20 applications 26.9.55.

APPENDIX XXX

Nursery manurial experiments—Comparative trials using trace element preparations and urea foliar spray

Plot: Twelve beds of baskets seedlings in the nursery containing 7200 seedlings divided into 24 plots. Half a bed containing three units of 100 seedlings each, constitutes a plot.
Replication: 3. *Layout:* Randomized.
Growth of Measurement Data:
Treatments: (1) A. Es-Min-El (4 lb. in 100 gallons) in 1 per cent solution of Urea sprayed.
(2) B. Tracel for Coffee (4 lb. in 100 gallons) in 1 per cent solution of Urea sprayed.
(3) C. Control—No treatments.
(4) D. (Fritted trace Elements) F.T.E. applied to the soil in the baskets at 0.1 gm. per seedling (1 lb. per 400 sq. ft.) plus 1 per cent solution of Urea sprayed.
(5) E. Cu. Zn. Mn. spray (4 lb. in 100 gallons) in 1 per cent solution of urea sprayed.
(6) F. Es-min-el applied to the soil in the baskets @ 0.1 gm. per seedling (1 lb. for 400 sq. ft.) plus 1 per cent urea solution sprayed.
(7) G. Urea only—1 per cent Urea solution sprayed.
(8) H. Nuiron (3 lb. in 100 gallons) in 1 per cent Urea solution sprayed.

Growth measurements data	Treatments								Standard error as % of gen. mean.	Critical difference		Significant or not		Conclusions	
	A	B	C	D	E	F	G	H		P=0.01	P=0.05	P=0.01	P=0.05	P=0.01	P=0.05
I. Height in inches of seedlings (Average of five)	2.6	2.3	2.5	2.3	2.4	2.5	2.7	2.6	6.32	0.66	0.48	No	No	GAHCFEBD	GAHCFEBD
1. Before applications 26.4.55															
2. After 2 applications 26.5.55	3.2	3.7	4.0	3.8	3.9	3.7	4.0	3. 9	3.00	0.48	0.34	Yes	Yes	CGEHDBFA	CGEHDBFA
3. After 4 applications 26.6.55	5.5	5.1	5.5	5.2	5.4	5.3	5.7	5. 2	2.65	0.60	0.43	No	No	GACEFDHB	GACEFDHB
4. After 6 applications 26.7.55	6.8	6.8	7.0	6.6	7.0	7.2	7.0	3.43	1.00	7.10	0.72	No	No	FGECHABD	FGECHABD
5. After 8 applications 26.8.55	9.1	9.6	8.6	9.4	9.5	10.0	9.9	10.0	6.17	2.49	1.79	No	No	FHGBEDAC	FHGBEDAC
6. after 10 applications 26.9.55	11.6	10.6	11.1	11.8	10.2	11.9	12.6	13.1	7.10	3.47	2.50	No	No	HGFDACBE	HGFDACEB
No. of primaries on 26-9-1955 (out of 10 observational plants)	0.67	0.67	1.33	2.67	1.00	1.00	2.00	3.00	5.88	2.35	1.69	No	No	HDGCEFAB	HDGCEFAB

II. Leaf Population:

1. Before application	26.4.55	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0	No	No	ABCDEFGH	ABCDEFGH
2. After 2 applications	26.5.55	4.9	5.3	5.5	5.4	5.5	4.8	5.0	4.9	5.55	1.21	0.87	No	No	ECDBGAHF	ECDBGAHF
3. After 4 applications	26.6.55	7.7	7.7	7.9	7.8	8.0	7.7	7.5	7.7	2.38	0.18	0.56	No	No	ECDFABHG	ECDFABHG
4. After 6 applications	26.7.55	10.2	10.4	10.3	9.6	10.4	9.9	10.0	10.3	4.31	1.84	1.33	No	No	BECHAGFD	BECHAGFD
5. After 8 applications	26.8.55	11.7	11.5	11.6	11.5	12.3	11.6	11.5	12.1	3.54	1.75	1.26	No	No	EHACFBDG	EHACFBDG
6. After 10 applications	26.9.55	12.4	12.5	13.0	13.7	13.1	12.8	14.1	15.2	4.72	2.65	1.91	No	No	HGDECFBA	HGDECFBA

III. Field performance: After planting. Growth measurements made on 27.12 1955—Average of five.

1. Height in inches ...		18.2	18.8	18.6	17.8	16.7	18.4	17.4	18.3	2.83	2.15	1.55	No	No	BCFHADGE	BCFHADGE
2. No. of primaries ...		5.5	5.3	3.9	4.4	4.1	4.5	3.7	5.7	7.61	1.47	1.07	Yes	Yes	HABFDECG	HABFDECG
3. Total length of primaries in inches ...		29.8	25.6	18.2	21.1	19.0	20.1	17.4	28.6	10.69	10.12	7.29	No	No	AHBDFECG	AHBDFECG

APPENDIX XXXI

Comparative Trial Using Rapidgro and other Nitrogenous Fertilizers

(For Treatments and other particulars, see Appendix XXIX.)

Data on Laboratory Analysis of Seedlings

Sl No.	Factor analysed	Values as average of three replications of three seedlings each								SEM %	Critical difference P=0.01	Critical difference P=0.05	Conclusions P=0.01	Conclusions P=0.05
		A	B	C	D	E	F	G	H					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Fresh weight of whole seedlings in gms-seedling	22.39	37.98	49.62	20.67	48.09	37.04	39.82	7.79	4.400	6.099	4.394	CEGBFADH	CEGBFADH
2	do leaves ...	7.92	17.92	22.53	8.35	24.41	17.49	17.91	2.91	2.548	1.602	1.154	ECBGFDAH	ECBGFDAH
3	do stalk ...	8.02	14.21	18.72	6.65	16.99	13.03	14.14	2.94	5.589	2.786	2.007	CEBGFADH	CEBGFADH
4	do roots ...	6.39	5.81	8.37	5.66	6.69	6.40	7.76	1.94	8.174	2.100	1.520	CGEFABDH	CGEFABDH
5	Dry weight of whole seedlings in gms/seedling	7.075	12.123	14.289	6.218	14.221	11.370	11.716	2.050	1.220	0.508	0.365	CEBGFADH	CEBGFADH
6	do leaves ...	2.168	5.287	5.729	2.153	6.135	4.836	4.624	0 565	4.357	0.724	0.531	ECBFGADH	ECBFGADH
7	do Stalk ...	2.776	4.812	6.060	2.314	5.828	4.282	4.797	1.004	5.573	0.935	0.674	CEBGFADH	CEBGFADH
8	do roots, ...	2.13I	2.023	2.500	1.751	2.259	2.251	2.295	0.482	6.145	0.508	0.366	CGEFABDH	CGEFABDH
9	Length of stalk from tip to collar in centimeter/seedling	38.6	49.1	53.7	35.7	49.9	44.3	47.8	25.1	2.776	5.029	3.623	CEBGFADH	CEBGFADH
10	Girth of stalk at collar zone in tenth of millimeter per seedling ...	60.1	66.3	76.1	63.6	75.1	63.8	66.2	44.2	4.228	11.400	8.212	CEBGFDAH	CEBGFDAH
11	Fresh weight of leaf in milligrams/square centimeter	24.12	21.82	23.52	23.98	25.51	26.41	24.86	22.47	2.201	2.230	1.607	FEGADCHB	FEGADCHB
12	Dry weight of leaf in mgs. centimeter ...	6.45	5.86	6.00	5.83	6.32	6.22	6.12	4.89	17.02	4.263	3.077	AEFGCBDH	AEFGCBDH
13	Moisture in leaf ...	17.67	15.96	17.52	18.15	19.19	20.18	18.75	17.59	2.338	1.784	1.286	FEGDAHCB	FEGDAHCB
14	Percentage of nitrogen in whole seedlings on fresh weight-basis ...	0.564	0.637	0.536	0.462	0.573	0.620	0.510	0.511	5.129	0.119	0.086	BFEACHGD	BFEACHGD
15	do leaves ...	0.692	0.823	0.656	0.544	0.691	0.781	0.627	0.625	7.782	0.223	0.161	BFAECGHD	BFAECGHD
16	do stalk ...	0.393	0.505	0.406	0.339	0.446	0.444	0.369	0.451	7.429	0.131	0.094	BHEFCAGD	BHEFCAGD
17	do roots ...	0.606	0.662	0.518	0.507	0.592	0.628	0.511	0,419	5.973	0.242	0.174	BFAECGDH	BFAECGDH

18	Whole seedlings on oven dry basis	1.774	1.992	1.859	1.536	1.903	2.019	1.744	1.932	3.099	0.761	0.548	FBHECAGD	FBHECAGD
19	do leaves ...	2.519	2.780	2.578	2.114	2.748	2.825	2.426	3.138	5.367	0.595	0.429	HFBECAGD	HFBECAGD
20	do stalk ...	1.136	1.358	1.254	0.974	1.254	1.349	1.087	1.336	4.965	0.262	0.189	BFHCEAGD	BFHCEAGD
21	do roots ...	1.797	1.901	1.729	1.634	1.752	1.784	1.729	1.652	3.798	0.279	0.201	BAFECGHD	BAFECGHD
22	Penultimate Nitrogen in milligrams per seedling in whole seedling oven-dry basis	126	241	266	96	276	229	205	39	6.002	42.11	30.34	ECBFGADH	ECBFGADH
23	do leaves ...	56.93	146.33	147.90	45.50	168.50	136.53	112.17	17.63	5.148	22.52	16.23	ECBFGADH	ECBFGADH
24	do stalk ...	31.47	65.23	76.01	22.50	73.10	57.80	52.20	13.27	6.759	44.54	31.73	CEBFGADH	CEBFGADH
25	do roots ...	38.27	38.30	43.47	28.63	39.57	40.20	40.03	7.97	8.139	12.12	8.73	CFGEBADH	CFGBEADH
26	Percentage of organic carbon in whole seedlings on fresh weight basis...	14.35	14.99	12.83	12.90	13.12	14.37	13.75	11.85	4.067	2.315	1.667	BFAGECDH	BFAGECDH
27	do leaves ...	12.40	13.65	11.32	10.71	11.04	13.57	11.73	8.84	6.437	3.160	2.277	BFAGCEDH	BFAGCEDH
28	do stalk ...	15.60	16.54	14.33	15.34	16.04	14.69	15.08	15.11	4.651	3.003	2.164	BEADHGFC	BEADFGFC
29	do roots ...	15.21	15.67	13.57	13.31	14.80	16.16	13.28	11.33	6.334	3.779	2.723	FBAECDGH	FBAECDGH
30	do in whole seedlings on oven-dry basis	45.29	47.01	44.50	42.94	44.38	46.80	40.64	44.55	2.538	4.838	3.485	BFGAHCED	BFGAHCED
31	do leaves ...	45.53	46.17	44.46	45.01	43.90	44.63	45.41	44.62	1.485	0.281	0.203	BAGDFHCE	BAGDFHCE
32	do stalk ...	44.93	44.93	44.24	44.07	45.18	44.66	44.33	44.58	1.332	0.251	0.181	EABFHGCD	EABFHGCD
33	do root ...	45 14	45.19	45.22	43.00	43.77	45.91	44.67	44.11	1.445	2.716	1.956	FCBAGHED	FCBAGHED
34	Penultimate organic carbon in mgms. per seedling in whole seedlings	3193.2	5683.1	6362.9	2670.5	6309.5	5328.8	5514.3	911.6	4.874	925.1	664.9	CEBGFADH	CEBGFADH
35	do leaves ...	983.3	2442.2	2549.2	894.8	2692 0	2380 3	2098.1	252.1	7.672	477.3	343.9	ECBFGADH	ECBFGADH
36	do stalk ...	1247.7	2162.2	2683.5	1023.0	2629.8	1913.5	2127.2	446.2	5.672	424.7	306.0	CEBGFADH	CEBGFADH
37	do root ...	962.2	911.7	1130.3	752.8	987.7	1035.0	1023.4	213.44	6.705	247.6	178.3	CFGEABDH	CFGEABDH
38	Carbon to nitrogen ratio in whole seedings ...	26.05	23.77	23.96	27.99	22.94	23.20	27.03	23.22	5.016	4.165	3.769	DGACBHFE	DGACBHFE
39	do leaves ...	18.86	16.70	17.30	19.75	16.00	17.40	18.71	14.27	8.002	5.895	4.247	DAGFCBEH	DAGHCBEH
40	do stalk ...	39.94	33.47	35.28	45.34	36.04	33.12	40.84	33.93	5.002	1.519	1.814	DGAECHBF	DGAECHBF
41	do root ...	25.14	23.84	26.24	26.31	25.75	25.06	26.27	26.71	4.382	4.735	3.411	HDEBGCAF	HDGCAFEB

APPENDIX XXXII

Insecticidal control of coffee stem borer (Xylotrechus quadripes Chev.)

Data recorded on Experiment No. 1

Locality: Coffee Research Station, Balehonnur, E_1 Block. *Started:* April 1953.
Layout: Randomized. *Plot size:* 5 rows of 16 plants=80 plants.
Replications: 4. *Treatments:* 9. *Total area under experiment:* 2.91 acres.

	Treatments	No. of healthy plants (initial)	No. of borer infested plants removed 1953–54	% of infestation	No. of healthy plants (Initial)	No. of borer infested plants removed (July 54 to June 55, 12 months)	% of infestation	No. of healthy plants (Initial)	No. of borer infested plants removed (July 55 to July 56 13 months)	% of infestation
A	Control (No treatment) ...	278	17	6.06	259	8	3.1	276	16	5.8
B	Hexidol-950 1 per cent ac. ...	295	11	3.90	290	8	2.8	312	2	0.6
C	Lindane W.P. 2 per cent ac.	288	22	7.50	289	6	2.1	254	5	2.0
D	G-1250 1 per cent ac. ...	288	12	4.24	279	5	1.8	261	9	3.4
E	Inexit W.P. 0.03 per cent ac.	277	8	3.02	279	7	2.5	286	2	0.7
F	Inexit Dust (20 per cent) 1:1 ash ...	287	17	5.79	270	17	6.3	297	13	4.4
G	Folidol E-605 Con. 0.37 per cent ac. ...	310	14	4.42	302	20	6.6	283	7	2.5
H	Folidol E-605 W.P. 0.11 per cent ac. ...	262	24	8.93	241	22	9.1	280	8	2.9
I	Gemmexane Emulsion Con. 0.15 per cent ac. ...	318	13	4.05	312	6	1.9	284	5	1.9

APPENDIX XXXIII

Insecticidal control of coffee Stem Borer

Data recorded on Experiment II

Locality: R. Block—Coffee Research Station, Balehonnur. *Started:* October, 1953.
Layout: Randomized. *Plot Size:* 2 rows of 40 plants=80 plants.
Replications: 4. *Treatments:* 4. *Total area under experiment:* 1.19 acres.

A	Control (No treatment) ...	318	2	0.40	318	9	2.8	311	12	3.9
B	B.H.C. 50 per cent W.P. 1 per-cent ac. ...	303	0	0.00	298	3	1.0	304	5	1.7
C	Chlordane 0.09 per cent ac.	314	3	0.97	301	5	1.7	308	7	2.3
D	Toxophene 0.1 per cent ac.	299	4	1.37	293	7	2.4	308	7	2.3

APPENDIX XXXIV

Insecticidal Control of Coffee Stem Borer Observations on Experiment III

Locality: Coffee Research Station Balehonnur.
Lay-out: Randomised. Replications: 4. Treatments: 4.*
Plot size: 4 rows of 10 plants each (Vacancies were counted).
Total area under Experiment: 0.51 acre.

* A. Aldrex (Aldrin 0.5% active concentration) 2 applications.
B. B.H.C. 50% W.P. (1% active concentration) 3 applications.
C. Control—No treatment.
D. Dieldrex-15 (Dieldrin 0.5% active concentration) 2 applications.

Treatments	No. of plants at start (July 54)	No. of borer infested plants removed (July 54 to June 55—12 months)	Percentage infestation	No. of plants at start (July 55)	No. of borer infested plants removed (July 55 to July 56—13 months)	Percentage infestation
A.	158	10	6.3	159	6	3.8
B.	160	6	3.8	160	2	1.3
C.	160	7	4.4	159	9	5.6
D.	159	6	3.8	160	2	1.3

APPENDIX XXXV

Observations on the use of different organophosphorus insecticides against Green Bug

(Experiment II on the control of Green Bug)

Locality: Merthikhan Estate (Mysore). Started: April 1956.
Lay-out: Randomized. Replications: 4. Treatments: 5.
No. of plants per sub-plot: 5.
Application of insecticides: 27-4-1956.
Initial counts on Green Bug population: 26-4-1956.

Treatments	Initial population of Green Bug 26-4-56	Population of green bug 1 week after treatment	% Increase (+) Decrease (—)	2 weeks after treatment	% Increase (+) Decrese (—)	3 weeks after treatment from initial	% Increase (+) Decrease (—) from initial
A. Folidol E-605-0.02%	3401	533	(—) 84.3	353	(—) 89.6	847	(—) 75.1
B. „ 0.015%	3240	547	(—) 83.1	490	(—) 84.9	942	(—) 70.9
C. Ekatox '20' 0.1%	3309	612	(—) 81.6	429	(—) 87.0	1052	(—) 68.2
D.H.E.T.P.-0.125%	4210	897	(—) 78.7	600	(—) 85.7	940	(—) 77.7
E. Control	2941	4037	(+) 37.3	5420	(+) 84.3	6289	(+) 113.8

APPENDIX XXXVI

Trials with systemic insecticides against green bug
Observations on Experiment V-Green bug

Locality: Coffee Research Station, Balehonnur.
Treatments: 4. *No. of plants for each treatment:* 4.

	Population of bugs in treatments							
	Systox		*Metasystox*		*Tetrax*		*Control*	
OBSERVATIONS	*Adults*	*Nymphs*	*Ad.*	*Nym.*	*Ad.*	*Nym.*	*Ad.*	*Nym.*
Initial infestation	140	835	191	1029	137	787	149	854
8 days after treatment	136	465	178	653	216	1128	205	1165
% Reduction (—) or increase (+) from initial	—3	—44.3	—6.8	—36.5	+56.5	+56.5	+37.6	+36.5
16 days after treatment	62	197	91	306	309	1517	319	1828
% Reduction (—) or increase (+) from 2nd observation	—57.4	—57.6	—48.8	—53.1	+31	+34.5	+55.5	+56.8
One month after treatment	11	54	13	69	202	1006	371	2108
% Reduction (—) or increase (+) from 3rd observation	—82.3	—72.6	—85.7	—77.4	—34.6	—33.6	+16.3	+15.3
% Reduction (—) or increase (+) from initial	—92.1	—93.3	—93.2	—93.3	+50	+28	+154.3	+147

APPENDIX XXXVII

Studies on the effect of insecticides on the host (Green Bug) parasite (*Coccophagus bogoriensis Kon*) Complex
Observation on Experiment VI

Observation	*White Oil Emulsion* 1 %						*Control*					
	Green bug Adults						Green bug Adults					
	Total	*H	*P	Nymphs	% parasitisation	% Increase or decrease of nymphs	Total	*H	*P	Nymphs	% parasitisation	Increase or dicrease of nymphs
Initial 3.4.1956 ...	174	145	29	1702	16.6	—	169	50	119	1935	30	—
Treatment 8.4.1956 ...	183	412	141	890	77.0	47. 8 (—)	169	52	117	2589	69	33. 8(+)
18.4.1956 ...	149	43	106	377	71.1	78. 0 (—)	173	64	109	2818	63	45. 5(+)
27.4.1956 ...	150	44	106	452	70.6	73. 4 (—)	197	70	127	2958	64	58. 0(+)
14.5.1956 ...	130	30	100	1499	76.9	1109 (—)	210	80	130	3250	62	68. 0(+)

*H—Healthy
P—Parasitised.

APPENDIX XXXVIII

Data on trials with organic pesticides against shot hole borer

Locality: Coffee Research Station, Balehonnur.
Lay-out: Randomised.
Treatments: 7

Application of insecticides:
First application: 17.8.1955
Second „ 19.9.1955

A. G-1250 (B.H.C. 25 per cent plus D.D.T. 25 per cent) 2 per cent.
B. B.H.C. 50 per cent W.P. 1 per cent.
C. Control (No treatment).
D. D.D.T. 50 per cent W.P. 1 per cent.
E. Pruning.
F. D.D.T. plus Euphytan Summer Oil (0.2% + 1.0 per cent).
G. B.H.C. „ „

Treatments	Initial counts 16.8.55	Observation on the pest infestation on 6.9.55	26.9.55	17.10.55	7.11.55	27.11.55	15.12.55	5.1.56	27.1.56	17.2.56	9.3.56	30.3.56	21.4.56
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
A	—	6	8	9	21	12	36	13	17	7	4	9	2
B	—	7	9	13	21	16	39	14	18	8	3	5	4
C	—	15	16	25	15	17	60	12	14	6	6	6	2
D	—	4	7	19	11	13	56	26	18	6	6	7	5
E	—	10	11	23	12	11	42	20	18	6	10	8	4
F	—	9	13	20	9	13	44	22	10	9	2	3	5
G	—	5	16	18	14	12	51	18	16	5	9	7	6

APPENDIX XXXIX

Data of spray experiment to compare the efficacy of different strengths of Bordeaux mixture

Locality: Crawford area, Coffee Research Station, Balehonnur. Lay-out: Randomised.
Replications: 4.
Treatments: 8. Started: June 1951.

A. Bordeaux mixture 2-2-40.
B. ,, 1½-1½-40.
C. ,, 1-1-40.

Treatments	Effective % age of leaf survival			Yield of ripe cherry in lb. acre.	
	Feb. 55	*Sept.* 55	*Feb.* 56	1954-55	1955-56
A. ...	59.75	61.69	41.55	6247	2929
B. ...	57.10	54.78	38.75	6029	2389
C. ...	49.05	53.46	36.95	6011	2089
Gen. Mean ...	55.30	56.64	39.08	6095	2469
Sig. or not ...	Yes	No	No	No	No
Crit. Difference ...	9.14	10.92	7.31	2828	1168
S.E.M. percentage ...	5.07	8.36	8.11	20.41	19.34
Conclusions ...	A B C	A B C	A B C	A B C	A B C

APPENDIX XL

Data of Experiment to find out the efficacy of adding Detergents, Wetters, Spreaders and Adhesives to Bordeaux Mixture

Locality: 'Q' Block, Coffee Research Station, Balehonnur. *Lay-out:* Randomised.
Replications: 4.
Treatments: 8. *Started:* May 1954.

Treatments	*Effective percentage of leaf survival*		*Yield of ripe cherry in lb. per acre*
	Sept. 1955	*Feb.* 1956	1955-56
A. Bordeaux mixture 2-2-40	67.23	47.55	2685
B. ,, + 1½ oz Teepol in 40 gall. mixture	65.30	43.15	2305
C. ,, + 6 oz. Stanvac detergent ,,	68.70	47.55	1894
D. ,, + 7½ oz. Corvus oil in ,,	65.41	44.05	2053
E. ,, + 10 oz. Arkotine in ,,	This treatment discontinued		
F. ,, + 1½ oz. Lissapol N in ,,	67.30	49.75	1644
G. ,, + 1 oz. Agral LN in ,,	59.56	48.45	1839
H. ,, + 1.6 lb. Adhesive-Y.F. 3198 in 40 gall.	66.90	48.20	***
General Mean	65.79	46.96	2070
Significant or not	No	No	No
Critical difference	9.67	8.82	993.6
S.E.M. percentage	7.11	9.1	22.52
Conclusions	CFAHDBG	FGHACDB	ABDCGF

*** Only one replication is maintained due to want of sufficient materail and hence only EPLS is studied.

APPENDIX XLI

Data of spray experiment to compare the efficacy of proprietary fungicides with that of Bordeaux mixture

Locality: 'O&M' Block, Coffee Research. Station, Balehonnur. *Variety:* Coorgs Arabica.
Treatments 4 *Replications:* 4. *Started:* May 1953.
Lay-out: Randomised.

	Effective % age of leaf survival			Yield of ripe cherry in lb. per acre	
TREATMENTS	*Feb.* 55	*Sept.* 55	*Feb.* 56	1954-55	1955-56
A. Wetcol-15—3 lb. in 40 gal. water	53.01	55.85	46.20	3723	1638
B. Fungi-copper-Geigy—1 lb. in 40 gal. water ...	48.20	53.24	51.90	1780	2184
C. Cupravit-1 lb. in „ ...	43.50	51.61	48.35	3835	1609
D. Bordeaux mixture 2-2-40	52.25	59.46	49.70	3081	1675
General Mean	49.26	55.04	49.04	3104	1777
Significant or not	Yes	No	No	No	No
Critical difference	8.98	8.39	5.03	2364	694.7
S.E.M. percentage ...	5.92	6.99	4.71	23.81	17.24
Conclusions	A D B C	D A B C	B D C A	C A D B	B D A C

APPENDIX XLII

Data of spray experiment to compare the efficacy of proprietary fungicides with Bordeaux mixture

Locality: Shegode Estate, Balehonnur *Replications:* 4
Treatments: 6 *Lay-out:* Randomised. *Started:* September 1954.

	Effective percentage of leaf survival			*Yield of ripe cherry in lb. per acre*	
TREATMENTS	*Feb.* 1955	*Sep.* 1955	*Feb.* 1956	1954-55	1955-56
A. Bordeaux 2-2-40	55.45	74.03	35.90	2270	2517.50
B. Perenox—1 lb. in 40 gall. water	39.45	60.57	26.35	2287	2011.50
C. Blitox. „	45.20	71.03	43.15	1614	1762.50
D. Shell copper fungicide „	45.90	79.02	33.60	1387	1846.25
E. Parry's bye product 2½-2½-40	This treatment discontinued from Sept. 55 for want of material.				
F. Dithane Z-78—10 oz. in 40 gall. water	45.40	71.33	28.35	1850	1033.50
General Mean	47.13	71.19	33.47		1834.25
Significant or not	Yes	Yes	No		Yes
Critical difference	14.56	8.65	17.96		870
S.E.M. percentage	10.47	5.73	25.46		21.77
Conclusions	AEDFCB	DAFCB	CADFB		ABDCF

APPENDIX XLIII

Data of spray experiment to compare Mercurised copper oxychloride with Bordeaux mixture

Locality: 'Q' Block, Coffee Research Station, Balehonnur
Layout: Randomised.
Treatments: 6.
Replications: 4.
Started: Sep. 1954.

TREATMENTS		Effective % age of leaf survival	
		September 1955	*February* 1956
A.	Bordeaux mixture 2-2-40 ...	51.46	49.95
B.	Mercurised Copper-oxychloride—		
	„ 2 lb. in 100 gallons of water ...	66.59	49.50
C.	„ 3 lb. „ ...	54.51	45.45
D.	„ 4 lb. „ ...	57.96	40.95
E.	„ 5 lb. „ ...	57.57	42.70
F.	Copper sandoz-53—1 lb. in 40 gallons of water ...	51.58	49.45
	General mean ...	56.61	46.33
	Significant or not ...	No	No
	Critical difference ...	14.23	10.87
	S.E.M. percentage ...	12.05	11.25
	Conclusions ...	B D E C F A	A B F C E D

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